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U.S. Mines, Bureau of  
DEPARTMENT OF THE INTERIOR

FRANKLIN K. LANE, SECRETARY

BUREAU OF MINES

VAN. H. MANNING, DIRECTOR

COAL-MINE FATALITIES IN THE UNITED STATES

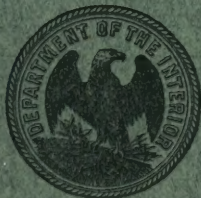
1870-1914

WITH

STATISTICS OF COAL PRODUCTION, LABOR, AND MINING  
METHODS, BY STATES AND CALENDAR YEARS

COMPILED BY

ALBERT H. FAY



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1915

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# CONTENTS.

	Page.
PART I.—Coal-mine statistics for the United States, by calendar years.....	3
Introduction.....	3
Source and scope of statistics. ....	4
Acknowledgments.....	5
Number of men employed.....	5
Underground and surface employees.....	6
Coal-mine fatalities in the United States, 1839-1914.....	7
Reduction in fatality rates and growth of mine-inspection service compared..	25
Coal-mine fatalities, by years and causes, from the beginning of inspection in 1870-1914.....	27
Coal-mine fatalities in the United States, by years, 1870-1914.....	27
Customary basis for computing fatality rates.....	60
Comparison of fatality rates on a uniform time basis.....	62
Principal causes of coal-mine accidents.....	65
Coal-mine disasters.....	65
Gas and dust explosions.....	73
Mine fires.....	75
Explosives.....	77
Permissible explosives.....	80
Falls of roof.....	82
Haulage systems.....	83
Accidents due to electricity.....	87
Mine shafts.....	90
Surface shops and yards.....	91
Accidents, classified by occupation.....	92
Nonfatal injuries in coal mines in United States.....	96
Fatalities at bituminous coal mines.....	104
Mining machines.....	107
Production.....	111
Number of men employed.....	111
Effect of machine mining on fatality rates.....	111
Causes of accidents.....	113
Gas and dust explosions.....	116
Explosives.....	116
Mining conditions.....	116
Fatality rates on basis of coal mined by machines.....	117
PART II.—Coal-mine statistics for each State, by calendar years.....	133
Introduction.....	133
Alabama.....	136
Area and distribution of coal fields.....	136
Coosa field.....	136
Cahaba field.....	137
Warrior field.....	137
Plateau field.....	138
Mining methods.....	139
Roof.....	139
Reportable accidents and organization of inspection service.....	140
Accidents.....	140

PART II.—Coal-mine statistics for each State, by calendar years—Continued.		Page.
Arkansas.....		146
Area and distribution of coal fields.....		146
Semibituminous field.....		146
Mining methods.....		146
Reportable accidents and organization of inspection service.....		147
Accidents.....		147
California.....		153
Area and distribution of coal fields.....		153
Accidents.....		153
Colorado.....		156
Area and distribution of coal fields.....		156
Character of coal beds.....		156
Mining methods.....		157
Reportable accidents and organization of inspection service.....		157
Accidents.....		158
Georgia.....		166
Area and distribution of coal fields.....		166
Accidents.....		166
Illinois.....		170
Area and distribution of coal fields.....		170
Character of coal beds.....		170
Mining methods.....		170
Reportable accidents and organization of inspection service.....		171
Accidents.....		172
Indiana.....		178
Area and distribution of coal fields.....		178
Character of coal beds.....		178
Mining methods.....		179
Reportable accidents and organization of inspection service.....		179
Accidents.....		181
Iowa.....		188
Area and distribution of coal fields.....		188
Character of coal beds.....		188
Mining methods.....		188
Reportable accidents and organization of inspection service.....		189
Accidents.....		190
Kansas.....		196
Area and distribution of coal fields.....		196
Character of coal beds.....		196
Mining methods.....		196
Reportable accidents and organization of inspection service.....		197
Accidents.....		198
Kentucky.....		204
Area and distribution of coal fields.....		204
Character of coal beds.....		204
Mining methods.....		205
Reportable accidents and organization of inspection service.....		206
Accidents.....		207
Maryland.....		213
Area and distribution of coal fields.....		213
Character of coal beds.....		213
Mining methods.....		214



## PART II.—Coal-mine statistics for each State, by calendar years—Continued.

## Maryland—Continued.

	Page.
Reportable accidents and organization of inspection service.....	215
Accidents.....	215
Michigan.....	222
Area and distribution of coal fields.....	222
Character of coal beds.....	222
Mining methods.....	222
Reportable accidents and organization of inspection service.....	223
Accidents.....	223
Missouri.....	228
Area and distribution of coal fields.....	228
Character of coal beds.....	228
Mining methods.....	228
Reportable accidents and organization of inspection service.....	229
Accidents.....	230
Montana.....	235
Area and distribution of coal fields.....	235
Character of coal beds.....	235
Mining methods.....	236
Reportable accidents and organization of inspection service.....	236
Accidents.....	237
New Mexico.....	243
Area and distribution of coal fields.....	243
Character of coal beds.....	243
Mining methods.....	244
Reportable accidents and organization of inspection service.....	245
Accidents.....	245
North Carolina.....	251
Area and distribution of coal fields.....	251
Character of coal beds.....	251
Reportable accidents and organization of inspection service.....	251
North Dakota.....	253
Area and distribution of coal fields.....	253
Mining methods.....	253
Reportable accidents and organization of inspection service.....	253
Accidents.....	254
Ohio.....	258
Area and distribution of coal fields.....	258
Character of coal beds.....	258
Mining methods.....	259
Reportable accidents and organization of inspection service.....	260
Accidents.....	261
Oklahoma.....	268
Area and distribution of coal fields.....	268
Character of coal beds.....	268
Mining methods.....	269
Reportable accidents and organization of inspection service.....	270
Accidents.....	270
Oregon.....	277
Area and distribution of coal fields.....	277
Mining methods.....	277
Reportable accidents and organization of inspection service.....	277
Accidents.....	277
Strikes and lockouts.....	278

PART II.—Coal-mine statistics for each State, by calendar years—Continued.		Page.
Pennsylvania (anthracite).....		281
Area and distribution of coal fields.....		281
Character of coal beds.....		281
Northern field.....		281
Eastern-middle field.....		281
Southern field.....		282
Western-middle field.....		282
Mining methods.....		282
Reportable accidents and organization of inspection service.....		284
Accidents.....		286
Pennsylvania (bituminous).....		294
Area and distribution of coal fields.....		294
Character of coal beds.....		294
Mining methods.....		295
Reportable accidents and organization of inspection service.....		296
Accidents.....		297
Tennessee.....		304
Area and distribution of coal fields.....		304
Character of coal beds.....		304
Mining methods.....		304
Reportable accidents and organization of inspection service.....		305
Accidents.....		306
Texas.....		311
Area and distribution of coal fields.....		311
Character of coal beds.....		311
Mining methods.....		311
Reportable accidents and organization of inspection service.....		312
Accidents.....		312
Utah.....		313
Area and distribution of coal fields.....		316
Character of coal beds.....		316
Mining methods.....		316
Reportable accidents and organization of inspection service.....		317
Accidents.....		317
Virginia.....		323
Area and distribution of coal fields.....		323
Character of coal beds.....		323
Mining methods.....		324
Reportable accidents and organization of inspection service.....		324
Accidents.....		325
Washington.....		330
Area and distribution of coal fields.....		330
Character of coal beds.....		330
Mining methods.....		331
Reportable accidents and organization of inspection service.....		331
Accidents.....		332
West Virginia.....		339
Area and distribution of coal fields.....		339
Character of coal beds.....		339
Mining methods.....		340
Reportable accidents and organization of inspection service.....		340
Accidents.....		341



PART II.—Coal-mine statistics for each State, by calendar years—Continued.	Page.
Wyoming.....	347
Area and distribution of coal fields.....	347
Character of coal beds.....	347
Mining methods.....	348
Reportable accidents and organization of inspection service.....	348
Accidents.....	349
Coal-mine fatalities in the United States, by States and causes, during the calendar year 1915.....	354
Publications on mine accidents and methods of coal mining.....	355
Index.....	359

## ILLUSTRATIONS.

	Page.
PLATE I. Percentage of fatalities due to principal causes, by States, arranged in decreasing order of falls of roof.....	26
II. Number of men killed per 1,000 employed in the coal mines of the United States, by States and principal causes.....	26
III. Coal-mine fatalities computed on the basis of a 2,000-hour year, for a 10-year period, 1903-1913 (except 1909), for the various coal-producing States.....	64
FIGURE 1. Production, number of men employed, fatalities, and number killed per 1,000,000 tons mined, in coal mines of the United States, for which complete returns are available, 1870-1914.....	21
2. Relation between coal mine fatality rates in United States and the percentage of industry covered by inspection service, 1870-1914..	22
3. Number of men killed per 1,000 employed in the coal mines of the United States, by principal causes, 1870-1914.....	24
4. Total number killed per 1,000 employed in coal mines of the United States; also number killed per 1,000 employed, in common and in exceptional accidents, 1870-1914.....	68
5. Number of men killed per 10,000 employed, by explosives, in the bituminous coal mines of the United States, compared with the amount of permissible explosives used, 1901-1914.....	80
6. Average number of men killed per 1,000 employed in anthracite and bituminous mines of Pennsylvania, by occupation, 1902-1913.....	93
7. Analysis of nonfatal injuries showing part of body injured and percentage for each location.....	98
8. Fatality rates, by principal causes, in bituminous coal mines of the United States, 1891-1914, as compared with the increase in the percentage of machine-mined coal.....	104
9. Number of men employed in bituminous coal mines of the United States, by groups, based on percentage of coal mined by machines, 1896-1913.....	112
10. Total number killed, fatality rates, men employed, tons produced, and days active at the bituminous coal mines of the United States, by groups based on the percentage of coal mined by machines, 1896-1913.....	114
11. Number of men killed per 1,000 employed in bituminous coal mines of the United States, by principal causes, by groups based on percentage of coal mined by machines, 1896-1913.....	115
12. The total number killed per 1,000 employed in bituminous coal mines of the United States; also number killed per 1,000 employed, in common and in exceptional accidents, by groups based on percentage of coal mined by machine, 1896-1913.....	118
13. Tons mined per man per day and number of men killed per 1,000,000 tons mined in the bituminous coal mines of the United States, by groups based on the percentage of coal mined by machine, 1896-1913.....	119



# COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914, WITH STATISTICS OF COAL PRODUCTION, LABOR, AND MINING METHODS, BY STATES AND CALENDAR YEARS.

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Compiled by ALBERT H. FAY.

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## PART I.—COAL-MINE STATISTICS FOR THE UNITED STATES BY CALENDAR YEARS.

### INTRODUCTION.

The first data compiled by the Bureau of Mines relating to coal-mine accidents in the United States were published in Bulletin 69,<sup>a</sup> in which the total fatalities by years and States were tabulated from 1896 to 1912. Since the publication of Bulletin 69, further research has been conducted, with the result that the bureau is now able to publish for the first time all of the fatal accidents described in the State inspectors' reports by States, causes, and calendar years, from the beginning of inspection service to date. For the anthracite mines of Pennsylvania, there is a continuous record since 1870; the records of the Pennsylvania bituminous mines are continuous from 1877, and, with the exception of one year, the Ohio records are complete from 1874 to date. In fact, the records of all of the States, with few exceptions, are complete; and incomplete data for any year may generally be attributed to the fact that no report was published during that year.

The magnitude of the coal-mining industry in the United States is such that too much stress can not be placed on the need of safeguarding the three-quarters of a million men employed. Although the figures given herein show an appalling record for past years, they are not published for the purpose of proclaiming the high fatality rate of the past. They are a record of experience covering a period of 45 years, showing causes and results of many accidents in the coal mines of the United States. They represent a diagnosis of the hazard of the mining industry, pointing out the principal physical causes of accidents, and make available a body of uniform facts that will serve as a basis of preventive measures for use in future operations. It is with these great purposes in view that the Bureau of Mines presents the classified data in this report.

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<sup>a</sup> Horton, F. W., Coal-mine accidents in the United States and foreign countries: Bull. 69, Bureau of Mines, 1913, 102 pp.

Classification and study of mine accidents on the basis of number of persons killed is common and very old, but fails to throw enough light upon the problem involved. Many serious accidents in mines have no fatal results, hence in a tabulation of fatalities they are overlooked and the real hazard of the industry is not made clear. An accident does not necessarily include an injury that may result therefrom. Such accidents as the breaking of a hoisting cable, an explosion of powder, gas, or dust, a runaway car or motor are all serious. Although no loss of life results, they should be recorded, investigated, and studied to prevent their repetition.

No accurate data for the United States are available showing how far the personal element as related to the miner and his co-worker, the mine foreman, or to the superintendent and others in authority, contributes to accidents. Many accidents are due to inexperience on the part of the miner, his failure to heed orders, a misunderstanding of instructions and last, but not least, carelessness of himself or his fellow worker. A foreman or superintendent may fail to give proper warning regarding the conditions of certain parts of the mine; he may not have inspected certain rooms or entries on the day of a mine accident; the mine may not be properly equipped, or the operator may neglect to comply with the inspector's recommendations. There is, therefore, a personal element on the part of both the operator and the miner that must be considered. Legislation and the enactment of compensation laws will make the operator realize the seriousness of the mine-accident situation, when fatalities and injuries are to be paid for in legal tender of the realm. The miner must be educated and made to realize the dangers he encounters; he must learn that self-preservation and the safety of his fellow workmen should receive his first attention; he should cooperate with his employer, his associates, and the State mine inspector to the end that the mine hazard may be reduced to a minimum. "Cooperation for safety" should be the watchwords of the operator, miner, State inspectors, and all others in any way interested in the mining industry.

#### **SOURCES AND SCOPE OF STATISTICS.**

The fatalities classified in the State tables have been compiled from the State mine inspectors' reports. The details relating to each individual fatality, as published by the inspectors, have been carefully reviewed and the fatality classified according to the cause of the death as reported. The date of the accident has also been taken into consideration, so that all of the tables have been prepared on the basis of a calendar year. Thus, for the first time, the coal-mine fatalities of all the States are placed on the same basis. It is hoped that those States that classify fatalities by fiscal years will realize the value of a uniform classification and will adopt the calendar year as their basis. Inasmuch as figures based on the calendar year have been used throughout this bulletin, it has not been possible to make the State tables check



absolutely with the published reports of the inspectors. Some of the States have years ending June 30, others in May, September, October, or November.

In the compilation of these tables, all fatalities that were not directly attributable to the mining industry have been eliminated, including coke-oven accidents, suicides, natural causes, and murders. In a number of the earlier reports accidents of this character were included in the inspectors' returns.

Data relating to the production since 1807, the number of men employed since 1889, the number of days worked, the number of mining machines in use since 1891, the percentage of coal mined by different methods since 1911, the spot value of the coal, and notes on the coal areas and distribution have been taken from the annual volumes of the Mineral Resources of the United States, published by the United States Geological Survey. The data relating to mining methods have been compiled from both the reports of the United States Geological Survey and the State mine inspectors. It is not feasible to indicate the source of each individual item by footnotes, as that would be both burdensome and confusing. The general statement as above given, it is hoped, will indicate plainly the source of the data herein. Wherever practicable, footnotes have been inserted, showing the source of tables and direct quotations.

Notes relating to the mine-inspection service were compiled from the State mining laws and submitted to the individual State inspectors for verification and comment, and their corrections or additions have been included.

#### **ACKNOWLEDGMENTS.**

Acknowledgments are due to the following persons for technical assistance that has made possible the completion of the data compiled herein, and for suggestions that have been used in the preparation of the tables and other data: Dr. J. J. Rutledge, mining engineer, E. S. Boalich, mine statistician, and W. W. Adams, clerk, of the Bureau of Mines; M. R. Campbell, geologist, of the United States Geological Survey, who revised the notes on the various coal fields of each State; and the State mine inspectors, who supplied missing data and revised notes relating to the mine-inspection service of their respective States.

#### **NUMBER OF MEN EMPLOYED.**

Although the majority of the State mine inspectors' reports give the number of men employed in the coal-mining industry for each year, many of the reports are based on fiscal years, and as the fatalities have been classified according to calendar years, the actual number of employees would not be in accordance therewith. Some of the inspectors have included coke-oven employees, and as coke-oven accidents have been excluded, these workers should be omitted. It seemed best, however, that the number of employees should be ob-

tained from one source, as in so doing the statistics relating to employees would be on the same basis for all the States. The bureau has, therefore, used the number of employees as reported by the United States Geological Survey since 1889 (except 1909 and 1911). As the figures have been collected by one bureau, they are on a uniform basis and, furthermore, they are for calendar years and do not include coke-oven employees. For comparative purposes the number thus reported employed will be much better than one based on reports from 25 or 30 sources and for varying fiscal years.

The number of employees in the coal-mining industry for the year 1909 was compiled by the mining division of the Bureau of the Census and was published by the United States Geological Survey in 1910, as 666,552. In 1912 State figures for 1909 were compiled by the same bureau and published by the Bureau of Mines in Technical Paper 48,<sup>a</sup> in Bulletin 69,<sup>b</sup> and in each of the monthly statements of coal-mine fatalities to date. These publications have had wide circulation and have been used by many mining companies, State officials, and insurance organizations, and for this reason the figures showing coal-mine employees in 1909 as previously published by the bureau have been used in this bulletin.

The final census figures for 1909, published in 1913, show the number of employees on December 15, 1909, as 743,293. That figure, however, includes a certain number of coking establishments and, furthermore, as the coal-mining industry employs the largest number of men at that season of the year, the number reported on that date is too high to represent a fair average.

The census report for 1909, page 196, also gives the number of employees on the 15th day of each month during the year, the average of which is 681,090. The same report also gives the number of men employed on the 15th of each month during the year by States, the average of which is 680,872, as compared with 666,552, published by the United States Geological Survey and the Bureau of Mines. These two census figures, although agreeing closely, seemingly include certain coke workers. Taking everything into consideration, it is believed that the Bureau of Mines is justified in adhering to its first published figures (666,552), although this fails to check with the final census figures by about 2 per cent.

For the year 1911 the bureau collected accident statistics and at the same time obtained direct from the operators the number of men employed, both on surface and underground. The number of employees thus obtained has been used throughout this bulletin.

#### UNDERGROUND AND SURFACE EMPLOYEES.

Complete statistics showing separately the total underground employees, as well as surface employees at coal mines are not avail-

<sup>a</sup> Horton, F. W., Coal-mine accidents in the United States, 1896-1912, with monthly statistics for 1912, 1913, 74 pp.

<sup>b</sup> Horton, F. W., Coal-mine accidents in the United States and in foreign countries, 1913, 102 pp.



able. The number employed since 1889, as reported by the Geological Survey, is combined as one item, but coke-oven employees are not included. As there are no separate data for these two classes of employees, Table 6 has been prepared, the underground and surface employees being calculated on the basis of the 1911 returns to the Bureau of Mines. In this year 122,513 surface employees were reported at coal mines (exclusive of coke workers) or 16.82 per cent of the total. The total number employed each year since 1895 has been separated on the above basis, with underground and surface fatality rates calculated independently. The 20-year period chosen is considered sufficiently long to be thoroughly representative and thus to throw a little more light on the real underground hazard. For example, the fatality rate in 1913, based on all employees, was 3.725 per 1,000, whereas the underground rate was 4.218, or 13 per cent higher than the combined rate. The surface rate for the same year was 1.283. Similar comparisons with other years may be made.

#### COAL-MINE FATALITIES IN THE UNITED STATES, 1839-1914.

Table 1 shows by calendar years the total number of fatalities recorded for the coal-mining industry of the United States as compiled from the State mine inspectors' reports, and from other authentic sources. This table shows that since 1839 to the end of 1914, 53,078 men have been killed in and about the coal mines in the United States. This number, however, is not complete, as mining was carried on in all of the coal-mining States several years prior to inspection service, and as the number of fatalities that occurred in the early period of the industry has not been recorded, except for a few of the larger disasters in which 5 or more men were killed.

The 49,733 fatalities given in Table 2 represent those occurring in 89.46 per cent of the industry as based on the tonnage from 1807 to the end of 1913. The fatality rate per million tons mined during the 10 years from 1870 to 1879 was 8.70. If this figure be taken as representative of the early stages of the industry and applied to the remaining 10.54 per cent of the production from 1807 to and including 1909, not represented by accident statistics, an estimated 9,000 fatalities should be added to the 49,733, making the total to the end of 1913 as 58,733. The total fatalities to the end of 1914 are, therefore, 61,187, of which number 53,078 are accounted for in Table 1.

The total number of fatalities shown in Table 1 does not necessarily agree with the totals shown in Tables 2, 3, and 4, because in the latter tables only those fatalities have been included for which the corresponding number of men employed was obtainable. In Table 1 the figures covering 1888 to the end of 1914 do check with the above tables. Prior to 1888 the table covers a number of mine disasters in States in which the number of men employed was not obtainable. In the subsequent discussion of mine accidents Table 1 is ignored and the lessons to be drawn are based on Tables 2, 3, and 4, which contain complete comparable data for 49,733 fatalities.

TABLE 1.—COAL-MINE FATALITIES IN THE UNITED STATES, BY STATES AND YEARS, 1839 TO 1914.<sup>a</sup>

Year.	Alabama.	Arkansas.	California.	Colorado.	Georgia and North Carolina.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maryland.	Michigan.	Missouri.	Montana.	New Mexico.	North Dakota.	Ohio.	Oklahoma.	Oregon.	Pennsylvania (anthracite).	Pennsylvania (bituminous).	Tennessee.	Texas.	Virginia.	Washington.	West Virginia.	Wyoming.	Total.
1839.																								40				
1847.																								7				
1854.																								19				
1855.																								55				
1869.																								179				
1870.																								211				
1871.																								210				
1872.																								223				
1873.																								263				
1874.																								261				
1875.																								260				
1876.																								266				
1877.																								244				
1878.																								260				
1879.																								329				
1880.																								260				
1881.																								416				
1882.																								502				
1883.																								593				
1884.																								762				
1885.																								593				
1886.																								574				
1887.																								535				
1888.																								728				
1889.																								668				
1890.																								733				
1891.																								733				
1892.																								956				
1893.																								991				
1894.																								958				
1895.																								1,142				
1896.																								1,083				
1897.																								990				
1898.																								1,062				
1899.																								1,241				
1900.																								1,489				
1901.																								1,574				
1902.																								1,724				



1903.....	57	11	14	158	52	27	33	27	12	8	17	5	22	.....	124	42	.....	518	305	26	.....	7	.....	1	25	147	169	1,926	
1904.....	94	.....	.....	173	54	25	31	20	10	6	11	9	8	.....	117	29	.....	595	523	28	.....	9	.....	31	119	181	2,000		
1905.....	187	6	65	203	46	37	41	31	15	9	11	8	7	.....	126	41	.....	644	475	29	.....	7	.....	12	212	18	2,232		
1906.....	196	13	89	161	51	29	39	39	6	7	16	13	23	.....	151	44	.....	597	476	32	.....	4	55	22	277	30	2,138		
1907.....	154	13	107	192	53	40	37	32	3	6	10	21	34	.....	154	39	.....	708	799	30	.....	5	11	37	756	30	3,242		
1908.....	198	15	163	172	45	31	38	40	6	6	10	21	24	.....	113	46	.....	678	571	31	.....	4	.....	25	349	81	2,445		
1909.....	129	15	6	145	49	39	32	34	20	9	21	11	14	.....	110	48	.....	591	509	29	.....	15	27	39	336	30	2,642		
1910.....	149	15	2	158	51	33	47	36	15	7	14	12	16	.....	159	39	.....	601	521	38	.....	4	.....	32	329	36	2,821		
1911.....	209	12	0	172	51	38	42	44	15	8	19	11	11	.....	107	27	.....	639	515	11	.....	7	18	37	311	32	2,866		
1912.....	123	6	2	153	52	30	30	43	13	3	10	7	16	.....	135	39	.....	601	446	18	.....	2	19	65	13	381	36	2,419	
1913.....	124	12	2	164	46	26	28	48	13	3	10	20	272	.....	105	23	.....	518	509	35	.....	4	.....	21	24	22	257	26	2,765
1914.....	128	11	0	193	44	37	33	61	18	2	19	8	18	.....	61	51	.....	595	402	26	.....	11	22	27	17	536	51	2,454	
Total.....	1,980	182	16	1,892	70	3,840	843	881	850	711	294	104	397	211	586	10	2,574	860	4	18,497	9,875	885	36	377	607	666	5,324	631	53,078

*a* Figures in italics represent incomplete fatality records.

*b* Last three months of year only.

*c* Reports either not published or not available.

*d* Fiscal year ending June 30.

*e* Includes 1881.

*f* Includes last six months of 1883.





1900.....	269,684,027	1.14	448,581	260,164,397	96.47	432,448	96.40	1,490	3.44	5.79	174,724	212	602	2.84
1901.....	293,299,816	1.19	485,544	291,439,047	98.37	480,807	99.02	1,574	3.37	5.40	185,165	216	606	2.81
1902.....	301,590,489	1.22	518,197	296,087,066	98.37	510,217	98.46	1,724	3.38	5.81	172,092	197	581	2.95
1903.....	357,356,416	1.41	568,260	352,064,631	98.32	556,581	98.29	1,826	3.40	5.67	182,796	220	633	2.88
1904.....	351,816,398	1.26	533,693	339,164,812	96.40	573,373	96.58	1,995	3.48	5.88	170,007	202	592	2.93
1905.....	392,725,035	1.21	626,045	386,379,243	98.38	615,368	98.29	2,532	3.63	5.78	173,109	212	628	2.96
1906.....	414,157,278	1.24	640,780	405,955,888	98.02	630,283	98.36	2,138	3.39	5.27	189,876	209	644	3.08
1907.....	480,363,424	1.28	680,492	477,892,536	99.49	674,613	99.14	3,242	4.81	6.78	147,407	231	708	3.06
1908.....	415,842,698	1.28	690,438	409,309,857	98.43	678,873	98.32	2,445	3.60	5.97	167,407	195	603	3.09
1909.....	460,814,016	1.20	666,552	460,807,293	99.99	666,555	99.99	2,642	3.96	5.73	174,416	220	692	3.15
1910.....	501,596,378	1.25	725,030	501,596,378	100.00	725,030	100.00	2,821	3.89	5.62	177,808	220	682	3.10
1911.....	496,371,126	1.26	728,348	496,371,126	100.00	728,348	100.00	2,656	3.65	5.35	186,887	225	740	3.29
1912.....	534,466,580	1.30	722,662	534,466,580	100.00	722,662	100.00	2,419	3.35	4.53	220,945	225	740	3.29
1913.....	570,048,125	1.33	747,644	570,048,125	100.00	747,644	100.00	2,785	3.73	4.89	204,985	238	762	3.20
<b>Total.....</b>	<b>9,844,247,843</b>	<b>1.33</b>	<b>763,185</b>	<b>8,806,855,193</b>	<b>89.46</b>	<b>14,966,611</b>	<b>100.00</b>	<b>49,733</b>	<b>3.32</b>	<b>5.65</b>	<b>177,083</b>	<b>588</b>	<b>588</b>	<b>3.25</b>
1914.....	513,525,477	1.33	763,185	513,525,477	100.00	763,185	100.00	2,454	3.22	4.78	209,261	207	673	3.25

<sup>a</sup> Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Summation based on State mine inspectors' reports. (See Table 3.)

<sup>c</sup> Number employed 1870-1888 selected from State mine inspectors' reports; 1889-1914 (except 1909 and 1911), selected from Mineral Resources, U. S. Geol. Survey.

<sup>d</sup> Calculated on basis of production represented by inspection States.

<sup>e</sup> Bureau of Census.

<sup>f</sup> Bureau of Mines.

TABLE 2A.—NUMBER OF MEN EMPLOYED IN AND ABOUT THE COAL MINES IN THE UNITED STATES, BY STATES, 1880-1914.<sup>a</sup>

State.	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Alabama.....	6,864	10,642	9,302	10,075	11,294	10,859	10,346	9,804	10,597	10,733	13,481	13,967	17,370
Arkansas.....	677	938	1,317	1,128	1,559	1,493	1,218	1,507	1,900	2,555	2,313	2,800	3,144
California.....	253	364	1,256	1,187	1,158	1,125	1,190	1,177	1,381	284	373	2,378	3,428
Colorado.....	4,904	5,827	6,000	5,747	7,202	6,507	6,125	6,704	5,832	6,440	7,166	7,450	8,870
Georgia.....	733	425	6,850	5,467	7,736	6,729	6,848	7,113	469	534	507	7,081	791
Idaho.....	.....	6,80	6,80	6,80	6,70	6,95	6,61	6,18	6,88	637	676	.....	.....
Illinois.....	30,076	28,574	32,951	34,585	35,390	38,477	38,630	39,560	33,788	35,026	36,759	39,101	41,880
Indiana.....	6,448	5,489	5,879	6,436	7,644	8,603	8,530	8,806	8,886	8,971	9,712	11,720	12,968
Iowa.....	9,247	8,130	8,124	8,170	8,863	9,995	10,066	9,672	10,703	10,262	10,971	11,698	12,653
Kansas.....	5,956	4,523	6,201	6,559	7,310	7,339	7,482	7,127	6,639	7,197	8,000	8,450	9,928
Kentucky.....	5,144	5,259	6,355	6,724	6,581	8,083	7,865	7,549	7,983	7,614	7,461	8,480	10,367
Maryland.....	3,702	3,842	3,801	3,886	3,935	3,974	3,912	4,039	4,719	4,818	4,824	5,310	5,373
Michigan.....	261	3,180	3,223	2,800	162	223	320	320	3,537	715	1,261	1,704	2,376
Missouri.....	6,631	5,971	6,199	5,893	7,375	7,523	6,299	5,982	6,414	6,542	7,176	8,180	9,871
Montana.....	818	1,251	1,158	1,158	1,401	1,782	2,184	2,335	2,337	2,359	2,378	2,376	2,158
New Mexico.....	1,015	827	1,806	1,083	1,011	985	1,383	1,569	1,659	1,873	1,750	2,037	2,478
North Dakota.....	75	.....	.....	54	88	77	65	141	170	151	210	236	280
Ohio.....	19,343	20,576	22,182	22,576	23,931	27,105	24,644	25,500	26,410	26,986	26,638	27,638	32,111
Oklahoma.....	1,862	2,571	2,801	3,257	3,446	3,101	3,212	3,168	3,168	3,216	4,084	4,525	6,706
Oregon.....	160	208	2,100	90	110	88	3,414	254	254	190	124	111	187
Pennsylvania (anthracite).....	123,676	126,000	126,350	129,050	132,944	131,693	142,917	148,991	149,884	145,501	139,608	144,206	145,309
Pennsylvania (bituminous).....	62,084	61,333	63,661	66,655	71,931	75,010	71,130	72,625	77,272	79,611	82,812	92,692	101,404
Tennessee.....	4,031	5,082	5,097	4,926	4,976	5,542	5,120	6,531	6,337	6,643	6,919	7,846	8,046
Texas.....	543	674	787	871	996	1,062	1,642	1,983	1,766	2,130	2,110	2,846	3,081
Utah.....	551	429	621	646	576	671	1,670	679	1,704	739	713	1,208	1,713
Virginia.....	1,523	1,295	820	836	961	1,635	2,158	2,510	2,344	1,825	1,960	3,631	4,152
Washington.....	2,657	2,206	2,447	2,584	2,757	2,662	2,840	2,622	2,739	3,145	3,330	3,670	3,545
West Virginia.....	9,778	12,236	14,227	14,867	16,524	17,824	18,159	19,078	20,504	21,697	23,325	23,163	30,935
Wyoming.....	2,675	3,272	3,411	3,133	3,378	3,032	3,449	2,437	3,137	3,475	4,697	5,332	5,151
Total.....	311,717	318,204	332,147	341,943	363,309	376,204	382,879	393,342	397,701	401,221	410,635	448,561	485,544



State.	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Alabama.....	16,439	21,438	17,811	19,595	20,555	21,388	19,197	17,760	22,290	22,003	22,613	24,552	24,042
Arkansas.....	3,516	4,157	4,580	4,192	4,208	5,085	5,337	5,206	5,908	5,338	4,536	4,632	4,339
California.....	3,207	203	168	135	41	32	34	15	15	43	52	35	36
Colorado.....	8,956	9,229	8,123	11,020	11,368	14,223	14,223	11,472	15,804	14,373	13,000	11,960	10,998
Georgia.....	755	755	881	801	737	808	670	467	386	510	450	560	355
Idaho.....	d 70	d 86	c 57	761	737	606	c 39	170	c 19	c 54	420	117	254
Illinois.....	47,411	50,596	54,685	58,653	61,988	65,581	68,035	69,425	72,645	75,656	78,098	79,529	79,499
Iowa.....	13,457	17,017	19,587	25,323	20,970	21,022	18,380	20,937	21,878	20,901	21,651	22,235	23,173
Kansas.....	12,434	14,162	15,629	15,113	15,260	15,585	16,021	17,286	16,696	16,822	16,370	15,757	16,057
Kentucky.....	9,461	10,924	12,198	11,926	14,355	12,439	13,916	12,359	12,870	11,853	11,646	12,479	12,445
Louisiana.....	13,727	14,354	14,235	14,685	15,272	16,971	16,946	16,903	20,316	24,124	24,304	26,332	28,764
Maryland.....	5,827	5,839	5,671	5,948	6,438	5,880	6,079	8,004	3,809	6,079	6,102	3,645	5,403
Michigan.....	2,344	2,768	3,549	3,696	3,971	3,982	4,247	3,406	3,575	3,248	3,113	3,305	2,800
Missouri.....	9,739	9,544	10,137	8,962	9,537	8,448	8,988	9,188	9,691	9,607	9,704	10,418	9,849
Montana.....	1,938	2,155	2,505	2,181	2,394	2,735	3,146	4,335	3,837	3,804	3,400	3,630	3,550
New Mexico.....	1,849	1,789	1,849	2,108	2,070	2,970	3,448	3,317	3,585	3,700	3,928	4,329	4,178
North Dakota.....	402	486	454	626	488	502	631	972	46,641	45,459	45,327	45,815	45,401
Ohio.....	38,965	41,936	43,034	43,389	45,438	46,833	47,407	38,114	46,641	45,459	45,327	45,815	45,401
Oklahoma.....	5,574	7,704	8,487	7,712	8,251	8,398	8,651	8,089	8,657	8,729	8,785	9,044	8,078
Oregon.....	265	235	334	316	209	184	214	235	153	304	222	203	190
Pennsylvania (anthracite).....	148,141	150,483	155,861	165,406	162,355	167,234	173,174	166,801	169,497	173,940	174,030	175,745	179,679
Pennsylvania (bituminous).....	112,680	129,265	135,100	143,629	152,099	163,295	166,961	159,321	175,403	171,108	165,134	172,196	184,201
Tennessee.....	8,750	9,961	10,416	11,928	11,462	12,052	11,812	10,031	11,930	11,124	10,369	11,263	10,116
Texas.....	2,369	2,380	2,921	3,008	3,048	4,227	4,400	4,196	4,197	4,980	5,127	5,101	4,635
Utah.....	1,826	1,925	1,374	1,361	1,572	2,203	2,664	3,014	3,053	3,446	3,328	4,138	4,112
Virginia.....	3,912	5,608	5,165	5,730	5,131	6,670	6,208	6,191	7,294	8,107	8,678	9,162	9,183
Washington.....	4,404	4,768	5,287	4,765	4,529	5,945	5,484	5,992	6,314	7,236	5,919	5,794	5,805
West Virginia.....	35,500	41,554	47,235	48,389	50,900	59,029	56,861	55,433	68,043	66,800	68,248	74,786	78,963
Wyoming.....	5,250	4,993	5,660	5,977	5,934	6,645	6,915	7,123	7,771	8,118	8,036	8,331	8,117
Total.....	518,197	566,260	593,693	626,045	640,780	680,492	690,438	666,552	725,030	728,348	722,662	747,644	763,185

<sup>a</sup> Compiled from "Mineral Resources of the United States," U. S. Geol. Survey, except 1909, from Bureau of Mines.

<sup>b</sup> Includes North Carolina.

<sup>c</sup> Includes Alaska.

<sup>d</sup> Includes Nevada and North Carolina.

<sup>e</sup> Includes Nevada and North Carolina.

<sup>f</sup> Includes Alaska, Nevada, and North Carolina.

<sup>g</sup> Includes Alaska, Nevada, and Nebraska.

<sup>h</sup> Includes Nevada.

<sup>i</sup> Includes Alaska and Nevada.

<sup>k</sup> Includes Nevada and South Dakota.

TABLE 3.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEARS 1870-1914, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE. (FOR STATES HAVING COMPLETE INSPECTION RECORDS.<sup>a</sup>)

Year.	Killed underground.												Killed in shaft.				Killed on surface.						Grand total.	Table No.			
	Falls of roof (coal, rock, etc.)	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined). <sup>b</sup>	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.			Railway cars and locomotives.	Other causes.	Total.
1870.....	12	45	15	10	.....	8	1	.....	1	.....	20	71	193	4	.....	23	.....	27	1	.....	8	5	4	21	211	125	
1871.....	18	44	24	31	.....	16	2	.....	1	.....	.....	11	182	5	.....	1	.....	6	.....	3	.....	.....	.....	22	210	125	
1872.....	48	49	24	29	.....	16	.....	.....	1	.....	.....	16	179	13	.....	.....	9	20	.....	.....	.....	.....	24	223	125		
1873.....	18	47	36	32	.....	16	.....	.....	3	.....	.....	24	214	13	.....	5	.....	16	.....	14	.....	.....	.....	23	263	125	
1874.....	60	42	37	28	.....	16	4	.....	5	.....	.....	33	201	18	.....	7	.....	19	.....	13	.....	.....	.....	25	260	125	
1875.....	61	28	28	17	.....	33	1	.....	.....	.....	.....	33	216	15	.....	6	.....	26	.....	8	.....	.....	.....	23	260	125	
1876.....	54	43	36	27	.....	35	2	.....	1	.....	.....	14	212	9	.....	4	.....	15	.....	6	.....	.....	.....	23	249	125	
1877.....	73	64	27	16	.....	13	1	.....	.....	.....	.....	8	203	4	.....	.....	5	.....	.....	.....	.....	.....	.....	15	249	125	
1878.....	75	42	30	22	.....	17	.....	.....	2	.....	.....	16	204	1	.....	4	.....	8	.....	5	.....	.....	.....	14	225	125	
1879.....	112	58	47	33	.....	18	4	.....	1	.....	.....	16	284	5	.....	.....	6	.....	.....	6	.....	.....	.....	23	233	125	
1880.....	99	39	47	22	.....	15	.....	.....	2	.....	.....	18	247	6	.....	1	.....	7	.....	10	.....	.....	.....	26	317	125	
1881.....	102	42	66	28	.....	19	4	.....	3	.....	.....	29	295	6	.....	1	.....	9	.....	7	.....	.....	.....	20	274	125	
1882.....	150	55	61	34	.....	28	1	.....	6	.....	.....	35	369	14	.....	2	.....	28	.....	12	.....	.....	.....	36	340	125	
1883.....	170	43	59	37	.....	40	2	.....	6	.....	.....	110	467	15	.....	6	.....	25	.....	15	.....	.....	.....	50	542	125	
1884.....	184	59	82	44	.....	43	5	.....	6	.....	.....	60	465	17	.....	7	.....	24	.....	18	.....	.....	.....	49	538	125	
1885.....	197	66	44	30	.....	47	11	.....	2	.....	.....	60	457	17	.....	14	.....	33	.....	15	.....	.....	.....	54	549	125	
1886.....	185	62	54	60	.....	35	11	.....	5	.....	.....	20	421	13	.....	6	.....	33	.....	11	.....	.....	.....	49	494	125	
1887.....	180	96	79	22	.....	28	10	.....	5	.....	.....	17	438	18	.....	6	.....	24	.....	10	.....	.....	.....	38	504	125	
1888.....	255	81	82	22	.....	65	8	.....	6	.....	.....	36	568	9	.....	1	.....	41	.....	8	.....	.....	.....	44	594	125	
1889.....	265	87	90	33	.....	46	8	.....	8	.....	.....	37	624	21	.....	4	.....	45	.....	16	.....	.....	.....	59	668	125	
1890.....	262	78	84	76	.....	48	7	.....	8	.....	.....	54	848	18	.....	11	.....	45	.....	20	.....	.....	.....	64	733	125	
1891.....	345	94	98	158	.....	72	13	.....	4	.....	.....	55	902	20	.....	4	.....	37	.....	16	.....	.....	.....	71	848	125	
1892.....	349	108	111	104	.....	104	.....	.....	3	.....	.....	55	902	20	.....	17	.....	37	.....	20	.....	.....	.....	71	956	125	
1893.....	412	106	118	133	.....	62	.....	.....	6	.....	.....	35	838	27	.....	17	.....	52	.....	15	.....	.....	.....	86	991	125	

1874	305	79	109	41	14	86	3	1	6	50	34	817	39	10	19	58	16	16	15	12	24	83	958		
1875	408	95	123	137	88	99	11	1	9	1	25	1,014	55	1	20	49	25	18	17	12	34	70	1,432		
1876	490	93	119	63	65	72	5	3	6	1	44	892	21	3	10	41	10	11	12	27	80	1,895			
1877	437	122	96	49	33	58	2	3	2	1	37	888	16	4	13	39	15	11	8	9	20	62	1,993		
1878	488	103	132	61	38	75	4	5	6	2	34	944	18	11	16	41	18	12	4	11	22	77	1,962		
1879	560	100	141	98	33	83	5	12	7	2	56	1,107	21	4	16	44	24	12	4	17	27	90	1,941		
1880	557	105	157	115	205	121	8	17	3	1	43	1,333	26	11	24	61	25	10	6	18	30	95	1,489		
1881	622	127	194	107	146	137	6	12	8	4	89	1,402	32	12	23	67	30	29	6	16	24	105	1,574		
1882	605	117	188	184	249	130	1	13	3	4	63	1,575	27	7	26	60	28	1	22	10	7	189	1,724		
1883	790	130	221	279	8	196	3	18	9	3	50	1,712	45	5	13	64	58	26	5	22	39	150	1,826		
1884	779	156	215	66	235	190	8	20	6	7	7	1,739	57	14	28	99	51	27	6	21	42	147	1,905		
1885	957	138	247	173	177	181	8	25	6	6	20	1,980	48	3	27	78	31	39	8	35	50	164	2,232		
1886	902	138	256	189	176	197	2	53	6	8	35	1,868	44	11	36	92	62	3	36	2	16	59	178	2,138	
1887	1,036	154	344	154	802	221	12	52	13	9	123	2,938	46	10	30	86	70	4	44	10	33	218	3,242		
1888	945	168	312	89	286	203	4	54	12	7	90	2,209	42	10	25	77	59	7	36	4	23	159	2,445		
1889	1,025	204	307	153	142	191	5	58	10	5	69	2,445	20	6	21	47	50	2	31	4	16	47	150	2,642	
1890	1,092	222	380	145	352	195	13	79	9	11	10	49	2,557	39	3	34	80	83	2	40	9	12	38	184	2,821
1891	1,053	206	382	99	266	160	20	94	7	9	75	2,454	34	...	...	4	52	61	5	7	12	54	170	2,656	
1892	975	211	371	185	105	147	6	80	6	7	11	55	2,159	33	5	20	61	78	8	33	5	14	199	2,419	
1893	1,060	204	424	91	423	138	33	80	9	24	4	72	2,562	50	1	9	62	78	8	26	1	8	161	2,785	
Total	18,893	4,367	6,100	3,453	3,838	3,719	249	669	216	109	729	1,966	44,308	965	198	1,137	41	778	216	448	970	3,590	49,733		
1914	985	146	380	332	17	146	14	89	7	20	7	57	2,200	70	5	12	88	11	26	5	13	43	166	2,454	

<sup>a</sup> For percentage of the coal-mining industry represented, see Table 2.

<sup>b</sup> Prior to 1888 "coal dust" was not generally recognized as a cause of explosions, such disasters being attributed to "gas" only.



TABLE 4.—COAL-MINE FATALITIES IN THE UNITED STATES BY PRINCIPAL CAUSES, 1870-1914 (FOR INSPECTION STATES ONLY).

[See fig. 3.]

Year.	Falls of roof and pillar coal. (1 and 2)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 22)			Grand total.		Number of men employed. <sup>a</sup>
	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	
1870.	57	97.01	1.601	15	7.111	0.421	10	4.74	0.281	8	3.79	0.225	73	34.43	2.051	27	12.80	0.758	21	9.95	0.590	211	5.927	35,600
1871.	62	20.52	1.654	28	13.33	.417	31	14.76	0.297	16	7.02	.427	45	21.43	1.200	26	8.97	.447	22	10.48	.587	210	5.692	37,488
1872.	97	43.20	2.168	26	10.78	.536	29	13.09	.648	16	7.18	.358	13	5.83	.291	20	8.97	.447	24	10.75	.636	223	6.084	44,745
1873.	111	42.21	2.303	26	13.69	.541	22	10.17	.684	16	6.08	.332	19	7.22	.394	16	6.08	.332	33	12.55	.685	263	5.457	48,149
1874.	102	30.23	2.519	28	10.77	.529	22	10.77	.417	16	6.15	.238	33	12.69	.492	26	7.31	.283	25	9.62	.372	260	3.872	47,152
1875.	89	34.23	1.947	26	14.88	.421	17	6.54	.200	33	12.69	.388	34	13.08	.400	26	10.00	.305	33	12.69	.388	260	3.038	85,005
1876.	97	40.08	1.688	26	14.88	.421	27	11.13	.316	35	14.46	.410	17	7.03	.199	15	6.20	.175	15	6.20	.175	242	2.831	85,474
1877.	137	40.89	1.688	27	12.00	.333	16	7.11	.197	18	5.78	.201	17	7.44	.123	8	3.56	.099	14	6.22	.173	225	2.773	87,474
1878.	117	40.79	1.304	30	12.77	.334	29	9.36	.245	18	7.66	.201	17	7.36	.189	2	0.85	.022	20	12.34	.323	235	2.618	89,731
1879.	170	53.63	1.768	47	14.83	.489	33	10.41	.343	17	5.36	.177	25	11.33	.292	2	0.85	.022	26	12.34	.323	317	2.936	96,133
1880.	138	50.37	1.115	47	17.15	.380	22	8.03	.178	15	5.47	.164	38	14.18	.307	7	2.55	.056	30	7.30	.162	274	2.234	123,736
1881.	144	42.35	1.240	66	19.41	.568	28	8.23	.241	19	5.50	.172	41	9.15	.292	28	6.25	.172	51	11.38	.313	448	2.750	116,128
1882.	203	45.70	1.258	61	13.62	.374	37	7.59	.209	28	6.25	.247	118	21.77	.727	25	4.61	.154	50	9.22	.263	538	3.341	102,248
1883.	213	39.30	1.313	50	10.89	.364	37	6.83	.228	43	7.96	.224	53	9.55	.275	24	4.46	.125	49	9.14	.255	538	2.797	102,369
1884.	243	45.17	1.254	82	15.24	.296	30	5.46	.131	47	8.50	.220	73	13.30	.343	38	6.92	.178	54	9.92	.223	549	2.575	213,178
1885.	263	47.91	1.264	44	10.93	.246	60	12.15	.273	34	7.69	.173	34	6.88	.155	28	4.86	.109	49	9.92	.223	494	2.249	219,690
1886.	238	54.77	1.070	79	15.67	.345	60	12.15	.273	38	5.56	.123	34	6.55	.144	28	5.56	.123	38	7.34	.168	504	2.249	228,777
1887.	276	54.76	1.177	79	15.67	.345	42	4.36	.096	38	5.56	.123	57	7.83	.200	38	5.56	.123	44	7.34	.168	728	2.550	285,517
1888.	335	46.16	1.177	82	11.26	.287	106	14.56	.371	46	6.80	.162	57	7.04	.166	41	6.14	.143	50	8.83	.200	668	2.359	283,198
1889.	352	52.69	1.243	90	13.47	.318	33	4.94	.117	46	6.80	.162	76	10.37	.261	41	6.14	.143	64	8.73	.220	733	2.517	291,637
1890.	340	46.38	1.168	84	11.46	.288	76	10.37	.261	72	6.52	.165	76	10.37	.261	37	3.87	.119	64	7.43	.228	956	3.077	301,633
1891.	439	45.92	1.413	98	10.25	.315	163	17.05	.525	72	6.05	.189	60	7.05	.189	37	3.87	.119	54	5.45	.170	991	3.195	317,140
1892.	457	46.12	1.441	110	11.82	.332	215	21.70	.678	60	6.05	.175	60	7.05	.189	52	5.53	.146	68	7.10	.192	958	2.671	355,091
1893.	518	44.01	1.322	123	11.38	.304	95	8.87	.240	62	6.05	.175	93	9.71	.259	58	6.05	.169	83	6.69	.231	958	2.671	358,632
1894.	474	40.45	1.322	123	11.38	.304	95	8.87	.240	62	6.05	.175	93	9.71	.259	58	6.05	.169	83	6.69	.231	958	2.671	358,632
1895.	503	44.01	1.322	123	11.38	.304	95	8.87	.240	62	6.05	.175	93	9.71	.259	58	6.05	.169	83	6.69	.231	958	2.671	358,632
1896.	583	53.83	1.439	119	10.70	.313	128	11.82	.336	60	6.05	.175	60	7.05	.189	41	3.78	.108	80	7.36	.210	1,043	2.846	376,024
1897.	559	56.47	1.534	96	9.91	.247	128	11.82	.336	60	6.05	.175	60	7.05	.189	41	3.78	.108	80	7.36	.210	1,043	2.846	380,457
1898.	601	56.59	1.534	132	12.43	.337	69	6.50	.176	75	7.06	.191	67	6.31	.171	41	3.86	.105	77	7.25	.196	1,082	2.710	391,831
1899.	660	53.18	1.668	141	11.36	.357	131	10.56	.331	93	7.49	.235	82	6.31	.207	44	3.55	.111	90	7.25	.228	1,241	3.137	395,607

1900.....	662	44,461	1,531	157	10,541	363	320	21,491	740	121	8,131	280	73	4,901	169	61	4,101	141	95	6,381	219	1,489	3,443	432,448
1901.....	709	47,569	1,558	194	12,321	404	433	25,121	819	137	8,701	285	169	10,741	352	67	3,481	130	103	6,671	218	1,524	3,374	510,517
1902.....	726	47,111	1,423	188	10,911	397	431	25,121	816	130	7,541	255	169	5,681	392	60	3,481	118	86	5,161	218	1,724	3,370	510,517
1903.....	920	47,771	1,653	221	11,471	397	431	25,121	816	130	7,541	255	169	5,681	392	60	3,481	118	86	5,161	218	1,724	3,370	510,517
1904.....	935	46,871	1,631	215	10,781	375	391	15,091	525	190	10,181	352	88	4,571	158	64	3,321	115	150	7,791	259	1,926	3,460	553,373
1905.....	1,095	46,061	1,779	247	11,071	401	350	15,681	569	181	8,111	331	108	5,411	188	99	4,961	173	147	7,371	267	1,935	3,479	573,373
1906.....	1,040	48,641	1,779	247	11,071	401	350	15,681	569	181	8,111	331	108	5,411	188	99	4,961	173	147	7,371	267	1,935	3,479	573,373
1907.....	1,190	48,641	1,764	256	11,971	406	350	15,681	569	181	8,111	331	108	5,411	188	99	4,961	173	147	7,371	267	1,935	3,479	573,373
1908.....	1,113	45,521	1,840	312	12,761	460	375	15,341	552	203	8,301	290	205	8,431	304	77	3,151	113	218	8,721	282	2,138	3,392	634,283
1909.....	1,229	46,521	1,844	307	13,471	461	395	11,161	443	191	7,231	286	423	16,011	337	86	2,651	127	159	6,501	234	2,242	3,602	674,613
1910.....	1,314	46,581	1,812	380	13,471	524	497	17,621	686	195	6,911	269	171	6,061	236	80	2,841	110	184	6,321	254	2,642	3,602	674,613
1911.....	1,259	47,401	1,729	382	14,381	525	365	13,741	501	160	6,031	220	268	10,091	228	52	1,961	071	170	6,401	233	2,656	3,891	725,030
1912.....	1,186	49,031	1,641	371	15,321	513	290	11,991	401	147	6,081	204	165	6,821	228	61	2,521	083	199	8,231	275	2,419	3,847	728,348
1913.....	1,264	45,391	1,691	421	15,221	507	514	18,461	687	138	4,951	185	222	7,971	247	62	2,231	083	161	5,781	215	2,785	3,347	722,662
1914.....	23,280	46,761	1,554	6,100	12,271	403	7,271	14,661	437	3,719	7,481	248	3,938	7,921	253	1,835	3,691	123	3,590	7,221	240	49,733	3,323	763,185
Total.....	1,131	46,101	1,482	380	15,481	408	7,349	14,221	457	146	5,951	191	194	7,911	254	88	3,581	115	166	6,761	218	2,454	3,215	763,185

<sup>a</sup> See also Table 2. For inspection States only.

TABLE 5.—COAL-MINE FATALITIES, BY STATES AND PRINCIPAL CAUSES, DURING PERIODS ENDING DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.

(See Pls. I and II.)

State.	Period ending 1913.	Falls of roof and pillar coal. (1 and 2)		Mine cars and locomotives. (3)		Gas and dust explosions. (4 and 5)		Explosives. (6)		Miscellaneous underground. (7 to 12)		Total shaft fatalities. (13 to 16)		Total surface fatalities. (17 to 22)		Number killed.				
		Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Number killed.	Percentage of total killed.	Total.	Per 1,000 employed.			
Alabama.....	Yrs. 21	713	38.31	193	10.37	620	33.32	96	5.16	203	10.91	8	0.43	28	1.50	1,861	5.25			
Arkansas.....	9	65	60.75	2	1.87	2	1.87	15	14.01	20	18.69	2	1.87	1	.94	107	2.42			
Colorado.....	28	852	49.02	141	8.11	517	29.75	60	3.45	83	4.78	36	2.07	49	2.82	1,738	7.14			
Georgia.....	5	85	71.43	0	0	0	0	0	14.29	0	0	0	0	0	0	7	3.03			
Illinois.....	19	616	45.07	414	12.14	170	4.99	459	13.47	350	10.27	266	7.80	134	3.93	3,409	2.52			
Indiana.....	1	306	47.40	75	11.04	57	8.39	132	18.44	22	3.24	71	10.46	23	16	679	2.16			
Iowa.....	20	426	59.00	121	10.35	34	6.10	174	10.25	23	2.49	65	9.00	20	19	722	2.22			
Kansas.....	21	259	49.05	121	10.35	34	6.10	174	10.25	23	2.49	65	9.00	20	19	722	2.22			
Kentucky.....	23	316	49.76	46	12.25	74	11.65	131	24.81	61	12.50	24	3.78	08	47	635	1.98			
Maryland.....	23	127	57.73	36	16.64	0	0	89	14.02	28	6.14	24	3.78	08	47	635	1.98			
Michigan.....	14	151	52.04	113	2.04	0	0	15	2.27	94	16.36	13	0	22	10.00	19	220	1.87		
Missouri.....	26	235	62.17	110	2.03	40	10.58	15	15.31	33	15.31	10	10.20	22	5	11	98	2.16		
Montana.....	14	58	55.34	23	14.47	56	0	43	11.38	20	5.31	27	7.13	13	4	1.08	378	1.78		
New Mexico.....	21	160	28.17	43	7.57	321	56.51	24	4.23	48	2.82	0	1.63	9	5.06	22	159	5.89		
North Dakota.....	6	4	46.16	9	15.38	48	0	2	23.08	72	12.38	0	0	4	.70	568	11.43			
Ohio.....	30	1,509	65.84	277	12.08	29	2.79	161	7.02	115	5.02	72	3.45	08	87	3.80	09	2,292	2.39	
Oklahoma.....	21	153	20.99	14	78	10.70	58	252	35.94	196	10.84	59	25	3.43	19	17	723	5.45		
Oregon.....	5	1	33.33	90	0	2	66.67	179	0	0	0	0	0	0	0	3	2.69	0	0	
Pennsylvania (anthracite).....	44	7,378	41.65	2,403	13.56	1,344	7.59	1,790	10.10	35	9.24	843	4.76	16	2,321	13.10	.45	17,716	3.42	
Pennsylvania (bituminous).....	36	5,393	56.93	1,64	15.33	44	13.82	40	1.95	05	5.40	16	217	2.29	405	4.28	12	9,473	2.87	
Tennessee.....	23	361	42.03	1,81	49	5.70	339	29.47	5.70	3.14	13	1	1.12	33	3.84	116	859	4.30		
Texas.....	5	16	64.00	67	2	0	0	2	8.00	.09	12.00	1	4.00	.04	1	.04	25	1.06	0	0
Utah.....	22	95	26.76	248	7.04	205	57.75	5	3.40	13	1.97	1	.84	.08	15	4.23	.38	355	9.25	
Virginia.....	5	131	52.19	33	12.75	83	39.96	10	3.98	25	13.55	3	1.40	.03	18	7.17	.33	251	6.37	
Washington.....	25	182	28.44	1,75	81	12.63	78	195	32	5.00	30	102	13.94	98	35	4.47	.33	640	6.14	
West Virginia.....	20	2,452	51.64	557	17.73	1,036	21.82	109	3.27	16	4.25	21	67	1.41	279	5.88	.41	4,748	4.97	
Wyoming.....	6	114	47.30	22	9.13	67	27.80	13	5.40	28	7.05	37	1	.02	7	2.91	.15	241	5.21	
Total.....	.....	23,011	47.49	1,57	6,056	12.50	42	6,726	13.88	7.59	25	3,602	1,811	3.74	.12	3,572	7.37	.24	48,454	3.33



TABLE 6.—FATALITY RATES IN AND ABOUT THE COAL MINES IN THE UNITED STATES BASED ON UNDERGROUND AND SURFACE EMPLOYEES.<sup>a</sup>

Year.	Number employed.			Number killed.										Total.					
	Underground. <sup>a</sup>	Surface. <sup>a</sup>	Total. <sup>b</sup>	Underground.										Surface.					
				Falls of roof and pillar coal. (1 and 2)		Mine cars and locomotives. (3)		Gas and dust explosions. (4 and 5)		Explosives. (6)		Miscellaneous underground. (7 to 12)		Shaft. (13 to 16)		Underground (total).		(17 to 22)	
				Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.
1895.....	312,777	63,247	376,024	503	1.608	123	0.393	225	0.719	99	0.317	64	0.205	1,063	3.399	79	1.249	1,142	3.027
1896.....	316,481	63,996	380,477	583	1.842	119	0.376	128	0.404	72	0.227	60	0.190	1,093	3.169	80	1.254	1,080	2.846
1897.....	323,225	65,300	388,525	553	1.729	96	0.297	82	0.254	88	0.272	63	0.195	1,027	2.808	83	1.260	1,080	2.846
1898.....	325,933	65,908	391,841	601	1.844	132	0.405	69	0.212	75	0.240	67	0.205	985	3.022	77	1.168	1,062	2.710
1899.....	329,066	66,541	395,607	600	1.822	141	0.428	131	0.398	93	0.283	82	0.249	1,151	3.498	70	1.133	1,061	2.710
1900.....	330,710	72,738	403,448	662	1.840	157	0.476	320	0.800	121	0.376	73	0.203	1,394	3.875	95	1.306	1,489	3.137
1901.....	390,935	80,872	471,807	749	1.872	194	0.553	153	0.382	137	0.343	109	0.293	1,469	3.673	105	1.298	1,574	3.274
1902.....	424,399	85,818	510,217	726	1.711	188	0.443	433	1.020	130	0.306	98	0.251	1,635	3.832	83	1.037	1,724	3.379
1903.....	462,964	83,617	546,581	920	1.987	221	0.478	287	0.620	166	0.423	88	0.190	1,776	3.876	150	1.002	1,926	3.460
1904.....	476,932	86,441	563,373	935	1.961	215	0.451	301	0.631	190	0.398	108	0.226	1,848	3.875	147	1.524	1,995	3.479
1905.....	511,803	103,505	615,308	1,045	2.139	247	0.482	350	0.684	181	0.354	117	0.229	2,068	4.040	164	1.574	2,232	3.627
1906.....	524,750	106,014	630,764	1,133	2.120	344	0.613	956	1.704	221	0.394	127	0.200	1,960	3.739	178	1.679	2,138	3.802
1907.....	561,143	113,470	674,613	1,190	2.120	344	0.613	956	1.704	221	0.394	127	0.205	2,086	4.048	159	1.392	2,245	3.602
1908.....	584,187	114,186	698,373	1,229	2.116	370	0.654	295	0.552	191	0.345	123	0.205	2,437	4.495	151	1.338	2,588	3.944
1909.....	593,451	121,111	714,562	1,314	2.178	380	0.690	497	0.824	195	0.323	171	0.284	2,637	4.372	170	1.509	2,807	3.941
1910.....	603,451	121,950	725,401	1,314	2.178	380	0.690	497	0.824	195	0.323	171	0.284	2,637	4.372	170	1.509	2,807	3.941
1911.....	605,835	122,513	728,348	1,289	2.078	382	0.631	365	0.602	140	0.244	165	0.274	2,486	4.103	174	1.583	2,660	3.947
1912.....	601,190	121,513	722,703	1,289	2.078	382	0.631	365	0.602	140	0.244	165	0.274	2,486	4.103	174	1.583	2,660	3.947
1913.....	622,100	125,535	747,635	1,284	2.052	371	0.617	344	0.826	146	0.222	222	0.357	2,621	4.063	199	1.637	2,820	3.725
1914.....	630,334	123,851	754,185	1,131	1.769	380	0.694	349	0.546	146	0.228	194	0.304	2,288	3.579	166	1.340	2,454	3.215

<sup>a</sup> In 1911 the bureau collected statistics showing underground and surface employees as separate items. For this particular year the underground employees represented 83.15 per cent of the total and the surface employees 16.82 per cent. Inasmuch as there are no records prior to 1911 in which the surface and underground employees are shown separately, these items have been calculated on the basis of the 1911 returns as shown in this table. The 1914 figures were collected by the United States Geological Survey for both surface and underground employees.

<sup>b</sup> Mineral Resources, U. S. Geol. Survey, except 1909 (Bureau of Census) and 1911 (Bureau of Mines).

TABLE 7.—AVERAGE PRODUCTION, NUMBER OF MEN EMPLOYED, NUMBER OF FATALITIES AND RATES, AND DAYS WORKED IN THE COAL MINES IN THE UNITED STATES, BY STATES, FOR PERIODS DURING WHICH CONTINUOUS RECORDS ARE AVAILABLE.

State.	Period.	Production (short tons).	Number employed.	Number killed.				Production per death (short tons).	Days worked.	Average tonnage per man.		See Table No.
				Average per year.	Per 1,000 employed.	Per 1,000 200-day workers.	Per million tons mined.			Per year.	Per day.	
Alabama.....	1893-1913	10,533,707	16,863	88.62	5.25	4.39	8.41	118,865	239	625	2.62	85
Arkansas.....	1905-1913	2,131,396	4,919	11.89	2.42	3.08	5.55	180,117	157	435	2.77	87
Colorado.....	1886-1913	6,008,413	8,693	62.07	7.14	6.21	10.33	96,798	230	691	3.00	91
Georgia.....	1909-1913	207,356	461	1.40	3.03	2.29	6.75	148,111	265	450	1.70	93
Illinois.....	1885-1913	29,611,311	46,707	117.55	2.52	2.50	3.97	251,900	202	634	3.14	95
Indiana.....	1895-1913	10,301,629	16,581	35.74	2.16	2.31	3.44	291,062	187	627	3.35	97
Iowa.....	1888-1913	5,675,758	12,508	27.77	2.22	2.10	4.89	204,390	211	454	2.15	99
Kansas.....	1893-1913	5,107,848	10,280	25.14	2.45	2.53	4.92	203,153	194	497	2.56	101
Kentucky.....	1888-1913	7,144,744	12,361	24.42	1.98	1.97	3.42	292,541	201	578	2.88	103
Maryland.....	1889-1906	4,392,277	5,106	9.57	1.87	1.54	2.18	459,193	243	860	3.54	105
Michigan.....	1900-1913											
Missouri.....	1888-1913	1,406,433	3,234	7.00	2.16	2.12	4.98	200,919	204	435	2.13	107
Montana.....	1900-1913	3,337,180	8,185	14.54	1.78	1.83	4.36	229,511	195	408	2.09	109
New Mexico.....	1900-1913	2,115,567	2,921	11.36	3.89	3.26	5.37	186,276	239	724	3.03	111
North Dakota.....	1893-1913	1,771,859	2,366	27.05	11.43	9.45	15.27	65,509	212	749	3.10	113
Ohio.....	1908-1913	439,876	693	2.16	3.12	2.90	4.93	201,070	215	633	2.94	116
Oklahoma.....	1884-1913	19,188,032	31,949	76.40	2.39	2.54	3.98	251,152	188	601	3.20	118
Oregon.....	1853-1913	2,468,508	6,366	34.71	5.45	5.71	14.0	71,111	191	388	2.03	120
Pennsylvania (anthracite).....	1909-1913	57,834	223	.60	2.69	2.32	10.37	96,390	222	259	1.12	122
Pennsylvania (bituminous).....	1870-1913	50,316,598	117,851	402.64	3.42	3.42	8.00	124,908	200	427	2.14	124
Tennessee.....	1877-1913	69,596,423	89,076	256.03	2.87	2.51	3.98	271,832	229	781	3.41	126
Texas.....	1891-1913	4,454,854	8,689	37.35	4.30	3.77	8.38	110,280	228	513	2.25	128
Utah.....	1909-1913	2,061,793	4,720	5.00	1.06	.90	2.43	412,359	236	437	1.85	130
Virginia.....	1892-1913	1,440,197	1,744	16.14	9.25	7.28	11.20	89,252	254	825	3.25	132
Washington.....	1909-1913	6,959,917	7,880	50.20	6.37	4.92	7.21	138,644	259	883	3.41	134
West Virginia.....	1889-1913	2,396,305	4,167	25.60	6.14	4.95	10.68	93,606	218	575	2.32	136
Wyoming.....	1885-1913	26,299,767	32,955	163.72	4.97	4.52	6.23	160,035	220	708	3.63	138
	1908-1913	6,820,359	7,716	40.17	5.21	4.49	5.89	169,801	232	884	3.81	140

Figures for the total production of coal in the United States from 1807 to the end of 1914, and the total number of men employed in the industry since 1889 are given in Table 2 and are plotted in figure 1. The table and the figure show the total number of men killed in and about the coal mines in the United States for which complete records are available. It will be noted that in 1870 the percentage of the industry covered by the mine-inspection service (fig. 2), based on the production, was 47.42 with 35,600 men employed. The figures for the total number of men employed are not available. In 1871 the percentage of the industry represented by the production was 41.25 with 37,488 men employed. The figures for the first four years, 1870 to 1873, include only the anthracite mines of Pennsylvania. From 1874 on, a number of other States adopted inspection service, so that by the close of 1888, 87.29 per cent of the production was from States having inspection and representing 285,517 men. The first complete record of the number of men employed in all of the coal-mining States was in 1889, when 311,717 men were employed. Of this number, 283,198, or 90.85 per cent, were employed under the inspection service. The percentage of the production represented by in-

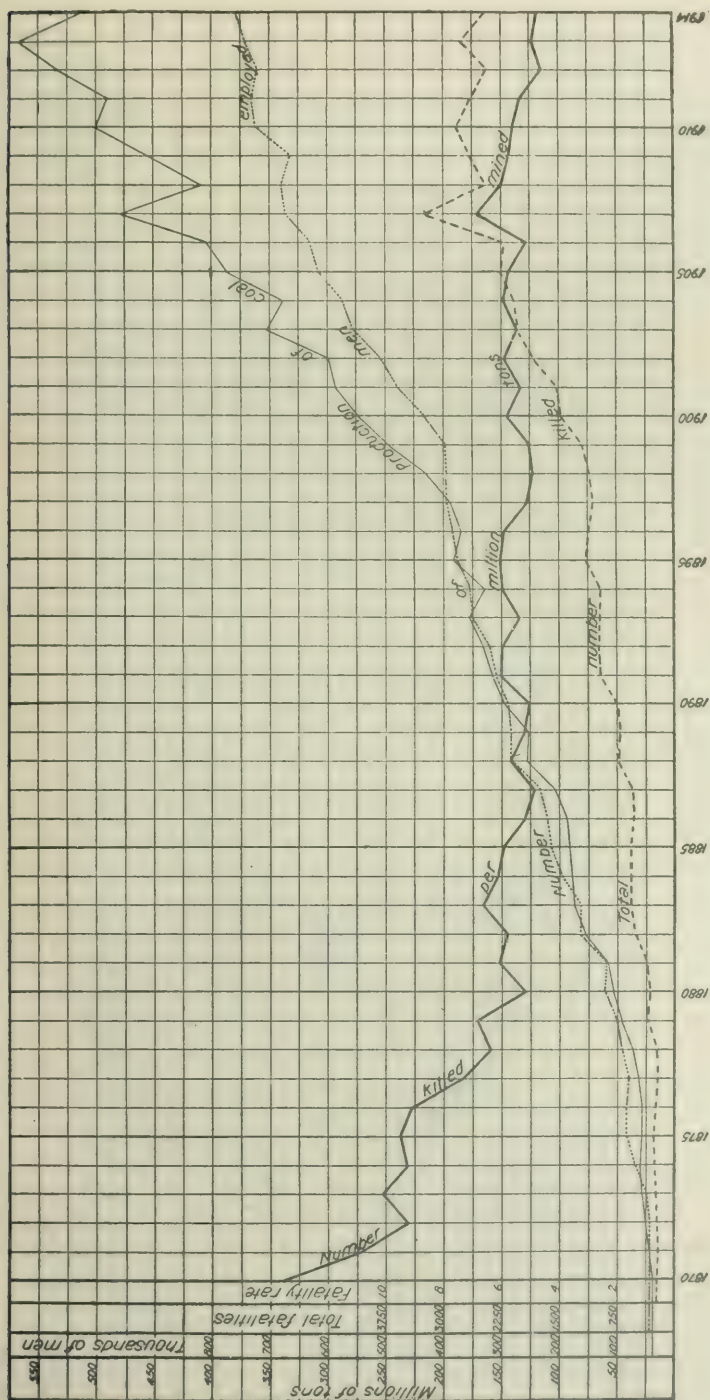


FIGURE 1. — Production, number of men employed, fatalities, and number killed per million tons mined, in coal mines of United States, for which complete returns are available 1870-1914. (Based on Table 2.)



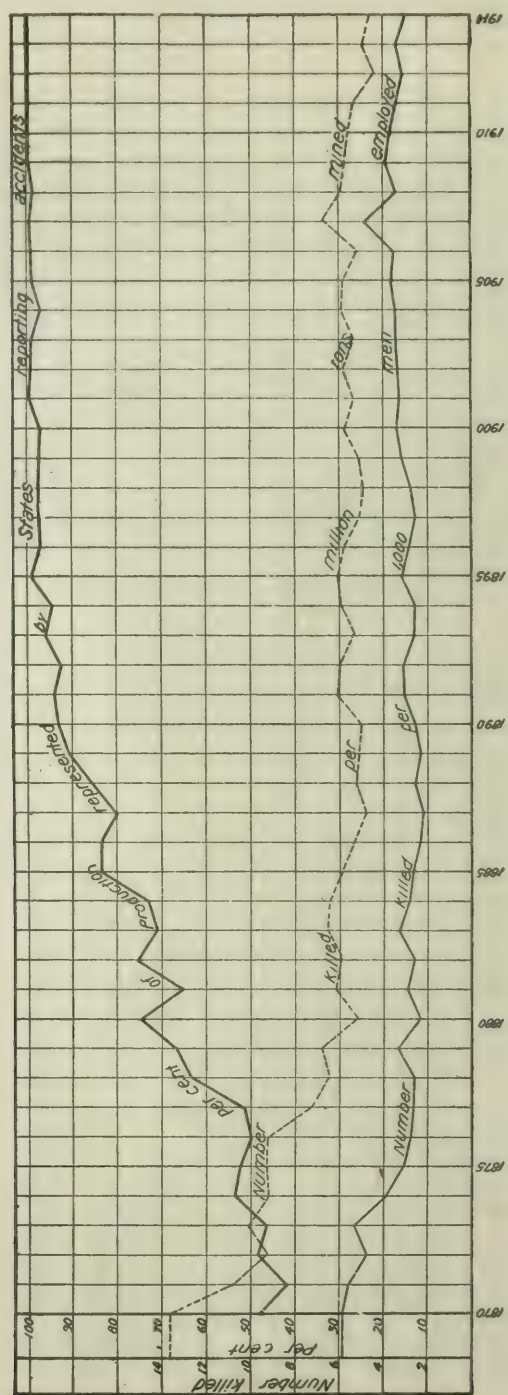


FIGURE 2.—Relation between coal mine fatality rates in United States and the percentage of industry covered by inspection service, 1870-1914. (Based on Table 2.)

spection States for the same year was 90.54. From 1889 to date the percentage of production and the number of men employed under inspection service agree with each other within less than 1 per cent. Beginning with 1910 complete figures are available for all of the States, thus representing 100 per cent of the industry. Beginning with 1870, the fatality rate per million tons mined was 13.47 (see fig. 2). This has been gradually reduced until in 1914 it was 4.78. The average amount of coal produced per man per year in 1870 was 440 tons, whereas in 1913 it was 762 tons, and in 1914, 673 tons. Although the figure for tons per man per year was less in 1914 than in 1913, the figure for tons mined per day per man was 3.25 in 1914 as compared with 3.20 in 1913.

Table 2A shows the number of men employed in and about the coal mines by States and calendar years from 1889 to 1914 inclusive.

Table 3 shows the total number of fatalities in the inspection States, for which reports were issued, by calendar years and causes, from 1870 to the end of 1914. This table is a summary of the State tables presented in Part II of this bulletin, as compiled from the State mine inspectors' reports.

Table 4 shows coal-mine fatalities by principal causes, the total number of fatalities, the percentage of the grand total, and the number killed per 1,000 employed (see fig. 3) for a period of 44 years, from 1870 to and including 1913. During this period 23,260 men were killed by falls of roof and pillar coal. The fatalities due to falls of roof and pillar coal in 1870 were 1.60 per 1,000 men employed, while in 1913 it was 1.69. There seems to be but little variation from these figures throughout the 44-year period, the average being 1.554.

Fatalities due to mine cars and locomotives (fig. 3) in the earlier years of inspection service show a slight decrease to about the year 1885. In 1885 the percentage of fatalities due to mine cars and locomotives was 8.01, or 0.206 per 1,000 men employed. Both the percentage and the rate per 1,000 men employed have increased until in 1913 the total percentage was 15.22, while the number killed per 1,000 employed was 0.567.

With reference to gas and dust explosions (fig. 3) both the percentage of the fatalities and the rate per 1,000 men employed are erratic. The lowest figure was in 1887, when 4.36 per cent of the total number of fatalities was due to gas and dust explosions, or practically one fatality per 10,000 men employed. This rate has increased in an irregular manner, reaching the highest point in 1907, when the total percentage of fatalities due to this cause was 29.49, or 1.417 fatalities per 1,000 men employed. Since 1907 there has been some reduction in both percentage and the rate per 1,000 men employed, but this is irregular and in all cases higher than it should be.

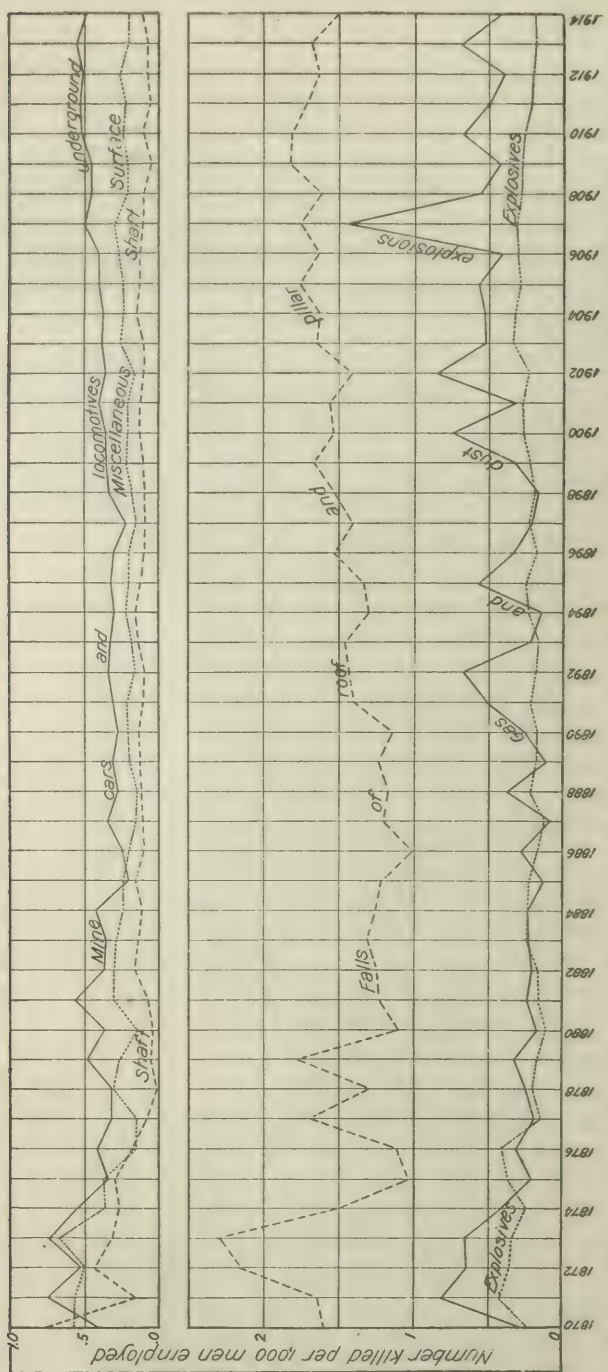


FIGURE 3.—Number of men killed per thousand employed in the coal mines of the United States, by principal causes, 1870-1914. (Based on Table 4, and covering inspection States only.)



Accidents due to explosives also show a decrease from the beginning of inspection to about 1887. From 1887 to 1903 there was an increase, and from 1903 to date the rate has gradually declined.

The fatalities due to shaft accidents (fig. 3) are gradually decreasing, the rate per 1,000 men employed in 1870 being 0.758, while in 1913 it was 0.083.

Table 5 contains the same grouping by causes as does Table 4. It, however, shows fatality rates by States for continuous periods for which records have been published. It contains 1,279 less fatalities than Table 4, by reason of the fact that intermittent records prior to the period of continuous records have been omitted. (See Pls. I and II.)

#### **REDUCTION IN FATALITY RATES AND THE GROWTH OF MINE-INSPECTION SERVICE COMPARED.**

The relation between mine-inspection service and the fatality rates at coal mines from 1870 to date is shown in figure 2. The upper curve represents the actual percentage of coal produced under inspection service to the close of 1909. From 1910 to 1914 the Bureau of Mines has received accident reports direct from the operators in those States wherein there is no mine inspection. These States are California, Georgia, Idaho, North Carolina, and Oregon. The coal produced in the noninspection States is less than 0.1 per cent of the total so that the curve from 1910 to 1914 may be accepted as representing the inspection service.

In 1869, 179 men were killed in a mine fire at Avondale, Pa. The following year a law provided for systematic inspection of the anthracite mines. Pennsylvania was therefore the first State to establish a mine-inspection system. From 1870 to 1873 the curve shown represents the anthracite fields only. The fatality rate in 1870 in the anthracite mines was 5.93 per 1,000 men employed, whereas the number of fatalities per million tons mined was 13.47. Corresponding figures for 1914 for the Pennsylvania anthracite field are 3.31 fatalities per 1,000 men employed, and 6.55 fatalities per million tons mined. There are no records to show what the fatality rate in anthracite mines was for years previous to 1870. It was, however, high in 1869, on account of the Avondale disaster. The year 1870 was apparently normal as shown by the actual number of men killed in the anthracite field during the next few years, so that the number of fatalities in 1869 must have been more than 350, with not to exceed 35,000 men employed.

The next State to appoint a mine inspector was Ohio, in 1874, and the first complete inspection year for the Pennsylvania bituminous mines was in 1878, so that after 1874 other States have been added to the inspection list.

Tables 8 to 39 show by years the number of inspection States for which complete records have been obtained, and it is upon these tables that the totals shown in Table 2 and the curves in figure 2 have been based.

During the first 10 years (fig. 2) of mine inspection the fatality rate per 1,000 men employed and the number of fatalities per million tons of coal mined declined rapidly. From 1880 to 1897 the fatality rate per 1,000 men employed remained practically stationary, while the number of fatalities per million tons mined showed a very slight reduction. From 1897 to 1907 the number killed per 1,000 employed increased considerably, reaching the highest point in 1907. Since that year there has been a marked decline.

The increase in the fatality rate from 1897 to 1907 is not necessarily due to less efficient mine inspection. The conditions under which mines were operated were changing. The mines were growing deeper; there were more old abandoned workings for accumulation of gas and dust; and more men were employed in the individual mines than in former years; so that in case of a gas or dust explosion, the likelihood of trapping more men was greater by reason of a larger number of men being employed. During this period there was an influx of foreign laborers, many of whom came from the agricultural districts of southeastern Europe. They had no experience in mining, did not know the English language, and hence were not capable of understanding and carrying out orders that were made in a tongue foreign to them. Although the inspection service has been increasing in efficiency from year to year, the various hazards, for the reasons mentioned, are also increasing.

The increasing fatality rate due to mine disasters, from 1897 and culminating with 1907, has been the means of the passage of more stringent laws concerning the operation of coal mines. Every disaster is thoroughly investigated by State and Federal authorities, as well as by the local engineers of the operating company, to determine the exact cause, so that similar disasters may be prevented in the future. States are establishing rescue and first-aid stations, and nearly every large mining company has its safety engineer and safety-first committees with the necessary rescue and first-aid equipment. An educational campaign on mine-accident prevention has been conducted since 1907 with the result that there is much closer cooperation of miner, foreman, operator, and inspector than in former years. Permissible explosives and improved types of safety lamps have been introduced into many of the mines. Explosibility of coal dust has been studied and precautions adopted to render the dust inert. The work of these various agencies has resulted in a gradual decline in the fatality rate from 1907 to 1914.

**COAL-MINE FATALITIES, BY YEARS AND CAUSES, FROM THE  
BEGINNING OF INSPECTION IN 1870 TO 1914.**

Tables 8 to 39, inclusive, show by causes and calendar years all of the fatalities occurring in and about the coal mines in the United States by combining those States for which there are complete inspection records. In the compilation of these tables all fatalities have been omitted for which the corresponding number of employees was not given. Thus one State may appear in a certain year and not in another simply because the records were incomplete. With reference to fatalities from 1870 to 1873, inclusive, which are represented only by the anthracite mines of Pennsylvania, the reader is referred to Table 125 under that State. The percentage of the industry covered by these tables, the number of men employed, and the fatality rate per 1,000 men employed, and per million tons of coal mined are shown in Table 2



TABLE 8.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEARS 1874-1877, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.							Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, sulfurated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	(Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	(Other causes.	Total.	
1874. <sup>a</sup>																											
Ohio.....	11	5				2			1			3	22	2	1			3	1			2			1	4	29
Pennsylvania (anthracite).....	49	37	37	25		14	4		4			21	194	6	2	7	1	16	7		5	5		4	21	23	
Total, 1874.....	60	42	37	28		16	4		5			24	216	8	3	7	1	19	8		5	7		5	25	260	
1875.																											
Ohio.....	10		1			3							14	3	4			7	1						2	3	24
Pennsylvania (anthracite).....	51	28	27	17		30	1					33	187	12		7		19	5		14	3		3	5	30	236
Total, 1875.....	61	28	28	17		33	1					33	201	15	4	7		26	6		14	3		3	7	33	260
1876.																											
Ohio.....	8	1	2			2							13			1		1							1	1	15
Pennsylvania (anthracite).....	46	42	34	27		33	2		1			14	199	9		5		14	5		5	1		1	2	14	227
Total, 1876.....	54	43	36	27		35	2		1			14	212	9		6		15	5		5	1		1	3	15	242
1877.																											
Ohio.....	11	6	9			1	1					1	29	1		1		2								31	
Pennsylvania (anthracite).....	62	58	18	16		12			1			7	174	3		3		6	5		3			1	5	14	194
Total, 1877.....	73	64	27	16		13	1		1			8	203	4		4		8	5		3			1	5	14	225

<sup>a</sup> For fatalities by causes for 1870, 1871, 1872, and 1873 see Table 125.

TABLE 9.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEARS 1878-1882, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.					Grand total.					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).		Machinery.	Bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.
1878.																										
Pennsylvania (anthracite).....	48	32	29	22		17	2		2				163	1	1				2	6		7	1	1	7	22
Pennsylvania (bituminous).....	27	10	1			1	2						41													7
Total, 1878.....	75	42	30	22		18	4		2				204	1	1				2	6		7	8	1	7	29
1879.																										
Pennsylvania (anthracite).....	85	43	41	29		17			1				229	5	1	1			7	10		7		4	5	26
Pennsylvania (bituminous).....	27	15	6	4									55													55
Total, 1879.....	112	58	47	33		17			1				284	5	1	1			7	10		7		4	5	26
1880.																										
Ohio.....	10		4			4							20	1		1			2	1						1
Pennsylvania (anthracite).....	64	26	38	21		11	4		2				14	5					5	5		8	1	3	17	202
Pennsylvania (bituminous).....	25	13	5	1					1				2						1	1				1	2	49
Total, 1880.....	99	39	47	22		15	4		3				247	6		1			7	7		8	1	4	20	274
1881.																										
Indiana.....																										
Pennsylvania (anthracite).....	73	36	54	25		19	3		2				10	6		1			2	9	12	13	3	2	5	35
Pennsylvania (bituminous).....	29	6	12	3					4				56						1			1				57
Total, 1881.....	102	42	66	28		19	3		6				295	6		1			2	9	12	14	3	2	5	36
1882.																										
Illinois.....																										
Ohio.....	3		2			5							39						2			1				1
Pennsylvania (anthracite).....	16	4		1		1							22													25
Pennsylvania (bituminous).....	90	31	51	25		20	1		2		3		228	12	8	2			22	9		13	1	7	11	41
Pennsylvania (bituminous).....	41	20	8			2							80	2					4	6			1	1	1	8
Total, 1882.....	150	55	61	34		28	1		2		3		369	14	8	6			28	15		15	1	8	12	51

TABLE 10.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEARS 1883-1884, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.							Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	(Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.	
1883.																											
Illinois.....	40			10								a 84	134													134	
Indiana.....												11	11													11	
Pennsylvania (anthracite).....	83	27	52	27		40	2		6			14	251	15	3	6			24	16	12	4	6	10	48	323	
Pennsylvania (bituminous).....	36	10	5									1	52						1	1					1	54	
West Virginia.....	11	6	2										19							1						20	
Total, 1883.....	170	43	59	37		40	2		6			110	467	15	3	7		25	18	12	4	6	10	50	542		
1884.																											
Illinois <sup>b</sup> .....	29											17	46													46	
Indiana.....												9	9													9	
Ohio.....	13	5	4	1		7							30	2				2								32	
Pennsylvania (anthracite).....	95	32	68	7		35	5		1		7	14	264	12	2	7		21	3	11	5	9	19	47	332		
Pennsylvania (bituminous).....	47	22	10	36	1	1							116		1			1		1		1	1		2	119	
Total, 1884.....	184	59	82	44		43	5		1		7	40	465	14	3	7		24	3	11	6	10	19	49	538		

<sup>a</sup> Includes 69 fatalities due to inrush of water.<sup>b</sup> Fiscal year ended June 30.



TABLE 11.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEARS 1885-1886, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.												Killed in shaft.						Killed on surface.						Grand total.	
													Total.						Total.							Total.
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.		
	1	2	3	4	5	6	7	8	9	10	11	12	Total.	13	14	15	16	Total.	17	18	19	20	21	22	Total.	
1885.																										
Illinois.....	25	6				8						7	39	2		4		6			2	1	2		5	
Indiana.....	2					5							7					2							7	
Kansas.....	1												1												9	
Kentucky.....	18	3				3							24	1		1		2							1	
Pennsylvania (anthracite).....	101	43	33	26		30	11		1			45	290	14	7	7		28	1		8	6	8	7	3	
Pennsylvania (bituminous).....	38	10	10	1		1			1			9	66					2	2						2	
Washington.....												3	6												3	
West Virginia.....	12	4	1	3									20								3				3	
Total, 1885.....	197	66	44	30		47	11		2			60	457	17	7	14		38	15		13	9	10	7	54	549
1886.																										
Colorado.....	3					2							5					4					1		1	6
Illinois.....	18	7	5										32	1	1	2									36	
Indiana.....												7	7												7	
Ohio.....	23	8	1										38	1				1							3	
Pennsylvania (anthracite).....	87	37	31	15		24	11		3			13	221	10	4	4		18	10		11	5	2	11	39	42
Pennsylvania (bituminous).....	38	10	15	6		2							71						1						2	74
Washington.....													3	1				1							3	4
West Virginia.....	4		1	39									44									3			3	47
Total, 1886.....	173	62	54	60		38	11		3			20	421	13	5	6		24	11		11	6	5	16	49	494

TABLE 12.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1887, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	(Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco- motives.	(Other causes.	Total.
Colorado.....	9	1	7	1	1	1	1	1	1	1	1	1	11	1	1	2	1	1	8	17	18	19	20	21	22	
Illinois.....	25	9	4	1	3	3	1	1	1	1	1	1	43	4	1	2	1	1	2	1	1	1	5	1	11	38
Ohio.....	10	10	4	1	1	20	10	1	5	1	1	15	28	10	1	1	1	1	12	10	11	1	1	5	11	38
Pennsylvania (anthracite).....	95	54	50	15	1	3	1	1	1	1	1	1	264	3	1	1	1	1	5	10	11	1	1	1	11	38
Pennsylvania (bituminous).....	31	21	17	5	3	3	1	1	1	1	1	1	79	3	1	1	1	1	5	10	11	1	1	1	11	38
Washington.....	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	11
West Virginia.....	9	1	1	1	1	1	1	1	1	1	1	1	11	1	1	1	1	1	1	10	11	1	1	5	11	38
Total, 1887.....	180	96	79	22	28	28	10	1	5	1	1	17	438	18	3	6	1	1	28	10	11	1	5	11	38	504

TABLE 13.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1888, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.												Killed in shaft.					Killed on surface.						Grand total.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Tages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.		Other causes.	Total.
Alabama.....																										(a)
Alaska and California.....																										(a)
Arkansas.....																										(a)
Arizona.....																										(a)
Colorado.....	12	3	4	5	3	2							29													(a)
Georgia and North Carolina.....																										(a)
Idaho and Nevada.....																										(a)
Illinois.....	25	7	4			8							45	4	1	3			8		1	1	1	1	4	67
Indiana.....													17	17												17
Iowa.....	10	2	2			9							24	2	1	2			5				1		1	30
Kansas.....						40							1	40												40
Kentucky.....			1			4							14													14
Maryland.....	9																									(a)
Michigan.....																										(a)
Missouri.....						24						3	27													27
Montana.....																										(a)
New Mexico.....																										(a)
North Dakota.....																										(a)
Ohio.....	16	9				2			1				28		1	3		4								32
Oklahoma.....																										(a)
Oregon.....																										(a)
Pennsylvania (anthracite).....	126	41	60	16		37	2		4				310	10	4	4		18	7		8	3	6	12	36	364
Pennsylvania (bituminous).....	39	14	9	1	17	3	1		1				2					1	1	1			1	1	2	90
Tennessee.....																										(a)
Texas.....																										(a)
Utah.....																										(a)
Virginia.....																										(a)
Washington.....																										(a)
West Virginia.....	18	5	2										25	1		1		2					1		1	28
Wyoming.....																										(a)
Total, 1888.....	255	81	82	22	84	65	3		6			48	646	17	7	14		38	8		9	4	9	14	44	728

<sup>a</sup> No inspection, or report not published.<sup>b</sup> Fiscal year ending Oct. 15.



TABLE 14.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1889, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.						Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.
Alabama.....																				17	18	19	20	21	22	
Alaska and California.....																										
Arkansas.....	5	4	3								11	23							1							
Colorado.....																										
Georgia and North Carolina.....																										
Idaho and Nevada.....	22	5	5	2		3						37							4							
Illinois.....																										
Indiana.....	11	2	2			2						17			1				4							
Iowa.....	6	2				2						11							1							
Kansas.....	9		1			2						12							5							
Kentucky.....	5											5														
Maryland.....																										
Michigan.....																										
Missouri.....	6	1	1			1						9							1							
Montana.....																										
New Mexico.....																										
North Dakota.....																										
Ohio.....	17	7	6			1						31							3							
Oklahoma.....																										
Oregon.....	128	41	60	24		32	8		3		18	314	6	1	12	1	20	11	11	6	10	13	51	385		
Pennsylvania (anthracite).....	48	22	10	6		2					2	90	2	2	2	3	7	4	2							
Pennsylvania (bituminous).....																										
Tennessee.....																										
Texas.....																										
Utah.....																										
Virginia.....	1			1								4	6													
Washington.....	7	3	2									1	13													
West Virginia.....																										
Wyoming.....																										
Total, 1889.....	265	87	90	33		46	8		3			36	568	9	1	27	4	41	16	17	18	19	20	21	22	568
																										14
																										1

a No inspection, or report not published.

TABLE 13.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1890, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
											Total.						Total.									
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	(Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
Alabama.....																										(a)
Alaska and California.....																										(a)
Arkansas.....																										(a)
Colorado.....	6	4	1	1		2							14	2				2								16
Georgia and North Carolina.....																										(a)
Idaho and Nevada.....																										(a)
Illinois.....	25	7	1	1		7					3	5	44		2	6		8				2	2	1	5	57
Indiana.....																										(a)
Iowa.....	4	1	1			3							5	1				1								5
Kansas.....	4												5					2								12
Kentucky.....	7	1				2							5			3		3								10
Maryland.....	4	1	3										8													8
Michigan.....																										(a)
Missouri.....	10		1	1		4							15	1		1		2				1				18
Montana.....		1											1													1
New Mexico.....																										(a)
North Dakota.....																										(a)
Ohio.....	23	7	3	1		2	1					1	38					1								39
Oklahoma.....																										(a)
Oregon.....																										(a)
Pennsylvania (anthracite).....	98	34	57	70		18	5		7			17	306	15	2	7		24	17		10	7	5	9	48	378
Pennsylvania (bituminous).....	62	19	16			5		1			31	3	137	2		1		3	2							145
Tennessee.....																										(a)
Texas.....																										(a)
Utah.....																										(a)
Virginia.....																										(a)
Washington.....																										(a)
West Virginia.....	18	3	1	2		1	1					1	7													7
Wyoming.....													25										1	2	4	29
Total, 1890.....	262	78	84	76		48	7		8		34	27	624	21	4	20		45	21		10	9	9	15	64	733

a No inspection, or report not published.

TABLE 16.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1891, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.				Killed on surface.						Grand total					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).		Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.
Alabama.....	1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16			17	18	19	20	21	22	
Alaska and California.....																										
Arkansas.....																										
Colorado.....	17	5	2		2	3					1	30														30
Georgia and North Carolina.....																										
Idaho and Nevada.....																										
Illinois.....	22	8	1	3	3	4						41	2	2								2	1	1	4	49
Indiana.....	2	2	1			1						4														
Iowa.....	19	2		1		4						25		1								1			1	27
Kansas.....	7		1			2					1	11		1											11	11
Kentucky.....	10	1	2									6		1							1				1	16
Maryland.....																										
Michigan.....																										
Minnesota.....	10	2	1			3	1					17														20
Montana.....	3	1	2			1						7		3												7
Missouri.....																										
New Mexico.....																										
North Dakota.....																										
Ohio.....	26	4	3			1			1		2	37										1			1	36
Oklahoma.....																										
Oregon.....																										
Pennsylvania (anthracite).....	123	44	59	39		41	12		3		2	34	357	13	2	5				8	13	3	7	20	51	428
Pennsylvania (bituminous).....	68	18	18	111		5					3	4	227	1	2	3				2			1		3	236
Tennessee.....	12	1				5					1		19							3						22
Texas.....																										
Utah.....																										
Virginia.....																										
Washington.....	1	2	2			1					5		11	1											2	14
West Virginia.....	25	6	6	5		1							43							2	1	1	1		4	47
Wyoming.....																										
Total, 1891.....	345	94	98	158	5	72	13		4		5	54	848	18	4	15			37	16	14	7	10	24	71	956

a No inspection, or report not published.



TABLE 17.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1892, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.												
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, sullicated, etc.).	Other causes.	Total.					Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	Grand total.			
													1	2	3	4	5									6	7	8
Alabama.....																												(a)
Alaska and California.....																												(a)
Arkansas.....																												(a)
Colorado.....	11	10	2	2	1	3							29	1	1	2												33
Georgia and North Carolina.....																												(a)
Idaho and Nevada.....																												(a)
Illinois.....	29	12	6	2		4					2	2	57	7	1	4												69
Indiana.....																												(a)
Iowa.....	13		1		3	2							19	19	1													21
Kansas.....																												(a)
Kentucky.....	4		1										5	1														8
Maryland.....	3	1	1						1				6															6
Michigan.....																												(a)
Missouri.....	12	2	1	3		2							20		1													22
Montana.....	1		2										3															3
New Mexico.....																												(a)
North Dakota.....																												(a)
Ohio.....	21	4	5		100	5						2	37	3														43
Oklahoma.....													100															100
Oregon.....																												(a)
Pennsylvania (anthracite).....	142	48	54	57		34						29	366	7														418
Pennsylvania (bituminous).....	76	18	31	1	2				2				128	1														134
Tennessee.....	10	1			2								13		1													13
Texas.....																												(a)
Utah.....	1					1							2															2
Virginia.....																												(a)
Washington.....																												55
West Virginia.....	3		3	46		5							53															55
Wyoming.....	23	12	3									2	45															45
Total, 1892.....	349	108	110	111	104	60			2		2	55	902	20	4	11		35	20			12		7	15	54		391

a No inspection, or report not published.

TABLE 13.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1893, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.							Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.	
Alabama.....	13	2									11	12	15							17	18	19	20	21	22		17
Alaska and California.....																											(a)
Arkansas.....																											(a)
Colorado.....	13	3	3		24	1							44			1			1				1				46
Georgia and North Carolina.....																											(a)
Idaho and Nevada.....																											(a)
Illinois.....	42	9	5	1		7							64	7		6	1		14	1			1	2	1	5	83
Indiana.....	16	2	1	3		5							20						1				1	1	1	2	22
Iowa.....	12	2			8	1							23						1								24
Kansas.....	3		1			2							5	1		2			3								14
Kentucky.....	9					1							10			1			1								12
Maryland.....	2	2	1										5														5
Michigan.....																											(a)
Missouri.....	13	1	1			1							16	1		1			2								18
Montana.....																											1
New Mexico.....	2	1		1									4														4
North Dakota.....																											(a)
Ohio.....	20	2	5			3							31	5				5									36
Oklahoma.....	2	1	1			1							6														6
Oregon.....																											(a)
Pennsylvania (anthracite).....	143	46	72	46	38				6		10	23	384	10	6	4			20	10		14	2	8	17	51	455
Pennsylvania (bituminous).....	86	19	16	1	2						4		129			1			1							131	1
Tennessee.....	3	3	2									3	11											1	2	13	0
Texas.....																											(a)
Utah.....																											0
Virginia.....																											(a)
Washington.....	4		3										7					1	1			1				9	1
West Virginia.....	35	13	7									2	57	3				1	3						1	2	62
Wyoming.....																											(a)
Total, 1893.....	412	106	118	53	32	62			6		14	35	838	27	6	17	2	52	15	1	4	11	22	68	358		

a No inspection, or report not published.

TABLE 19.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1894, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	(Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	(Other causes.	Total.
Alabama.....	11	1	2			2					4		20		1				1							21
Alaska and California.....																										(a)
Arkansas.....																										(a)
Colorado.....	11	2	1	1		1						1	17	1					1	1						19
Georgia and North Carolina.....																										(a)
Idaho and Nevada.....																										(a)
Illinois.....	25	3	3	2		14	1		1				49	2	1	2			5		1		1			57
Indiana.....																										(a)
Iowa.....	12	1	3			3							19	1		1			2			2	1			24
Kansas.....	10				2	4							16	3	2				5				2			24
Kentucky.....						2							9									1				10
Maryland.....	5	1	1										7													7
Michigan.....																										(a)
Missouri.....	10	1		4		1	1						17	1					1		1					19
Montana.....	5			6		1							11													11
New Mexico.....	4																									6
North Dakota.....																										(a)
Ohio.....	20	3	2	1		7							33	2		3			5			1				39
Oklahoma.....	3					2							8													11
Oregon.....																										(a)
Pennsylvania (anthracite).....	151	30	57	26		44					7	30	350	15	8	8			31	13	13	11	7	20	64	445
Pennsylvania (bituminous).....	66	25	22			4	1		4				117	3		3			6				1			123
Tennessee.....	12												12								1					14
Texas.....																										(a)
Utah.....													1													1
Virginia.....																										(a)
Washington.....																										50
West Virginia.....	41	11	11		8				1		37	1	49						1	2						50
Wyoming.....											2	2	76	1												79
Total, 1894.....	395	79	109	41	14	86	3		6		50	34	817	29	10	19		58	16	16	15	12	24	83	958	(a)

a. No inspection, or report not published.



TABLE 20.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1895, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.		
	Killed underground.										Killed in shaft.						Killed on surface.								
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Hallway cars and loco-motives.	Other causes.
Alabama.....	19	4	6	3		2	2						36	1				1							39
Alaska and California.....																									(a)
Arkansas.....													21												(a)
Colorado.....	6	6	3	4	2								39			2			2						39
Georgia and North Carolina.....				b 39																					(a)
Idaho and Nevada.....																									
Illinois.....	32	11	4		7	3	4					1	59	5	8	1			14	1	1		2		78
Indiana.....	12	12	3		3								18	3	2			5	3			1			23
Iowa.....	11	2	1				4	1			2		20	2		3			3						11
Kansas.....	5		2		1							1	8												13
Kentucky.....	4		3		6								1						2						9
Maryland.....	2																		1						(a)
Michigan.....																									
Missouri.....	6		1		5								12			1									13
Montana.....	4			1	2				1				8						1						8
New Mexico.....	3	1		24									28												28
North Dakota.....																									(a)
Ohio.....	21	7	7		11		1		1	1			49			1			1			1			51
Oklahoma.....	2		2	4									9												9
Oregon.....																									(a)
Pennsylvania (anthracite).....	147	38	53	32	46				6		1	23	346	13	1	4		18	17	13	4	7	16	57	421
Pennsylvania (bituminous).....	89	14	33	4					1			3	149	1		1		2			1	1		2	153
Tennessee.....	5	2			28	2							37												37
Texas.....																									(a)
Utah.....		1	1										1												1
Virginia.....																									(a)
Washington.....			1	26		1						3	36												39
West Virginia.....	40	8	4		5					4		3	60						4		1	2			64
Wyoming.....					60								60												60
Total, 1895.....	408	95	123	137	88	99	11	1	9	1	7	35	1,014	25	1	20	3	49	25	18	7	11	18	79	1,142

<sup>a</sup> No inspection, or report not published.

<sup>b</sup> Cummock mine explosion, North Carolina.

TABLE 21.--NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1896, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

[illegible]

a No inspection, or report not published.

TABLE 22.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1897, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.					Grand total.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).		Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	
Alabama.....	17	2	4	4	3						5	3	38									1				1	39
Alaska and California.....																											(a)
Arkansas.....	1	1	1		14								17													17	17
Colorado.....	15	4	3		12	1						1	36													36	36
Georgia and North Carolina.....																											(a)
Ideas and Nevada.....																											(a)
Illinois.....	33	11		5		12	1				1	1	64	4		1						1	1	1	1	4	73
Indiana.....	10		1			5							15	1												16	16
Iowa.....	12	2	1			2			1				18	3	1								1			1	23
Kansas.....	3					2							5													6	6
Kentucky.....	5		2			1						1	11		1											13	13
Maryland.....	3	1											5													5	5
Michigan.....																											(a)
Missouri.....	7	1	1			1							10													12	12
Montana.....	3	3	5										11													11	11
New Mexico.....	2	2	1										5													5	5
North Dakota.....																											(a)
Ohio.....	25	4	3	2	5	3		1			2		36				1					1	1		2	39	39
Oklahoma.....	6	1	3			4			1				24	1											1	28	28
Oregon.....																											(a)
Pennsylvania (anthracite).....	146	53	41	35		48	2				13	26	364	5	2	10					9	5	15	42	423	423	
Pennsylvania (bituminous).....	90	21	21	2	4			2					140	1	1	1						4	2	6	149	149	
Tennessee.....	10												10													10	10
Texas.....																											(a)
Utah.....	1	1											2													2	2
Virginia.....																											(a)
Washington.....	2		2									2	6												1	7	7
West Virginia.....	47	14	7	1		2							71	1							1	2	2	1	5	77	77
Wyoming.....																											(a)
Total, 1897.....	437	122	96	49	33	88	3	3	2		21	34	888	16	4	17	2	39	15		11	8	9	20	63	990	990

a No inspection, or report not published.



TABLE 23. NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1898, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
	Falls of roof (coal, rock, etc.).		Falls of face or pillar coal.		Mine cars and loco-motives.		Gas explosions and burning gas.		Coal-dust explosions (including gas and dust combined).		Explosives.		Suffocation from mine gases.		Electricity (shock or burns).		Animals.		Mining machines.		Mine fires (burned, suffocated, etc.).			Other causes.		Total.		Falling down shafts or slopes.		Objects falling down shafts or slopes.		Cages or skips.		Other causes.		Total.		Mine cars and mine locomotives.		Electricity (shock or burns).		Machinery.		Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.		Other causes.		Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	1	2	3	4	5	6	7	8	9	10	11	12	Total.	13	14	15	16	Total.	17	18	19	20		21	22	Total.	23	24	25	26	27	28	29	30	Total.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Alabama.....	22	2	9	10								1	44								1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		</

a No inspection, or report not published.

TABLE 24.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1899, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.							Killed on surface.							Grand total.	
																										Total.
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	(Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco- motives.	Other causes.		
Alabama.....	13	3	5	5		4	1				11	12		36	1		1		2					2	40	
Alaska and California.....																									(a)	
Arkansas.....																									(a)	
Colorado.....	28	3	6	6	23	1								38			1		1	1				1	70	
Georgia and North Carolina.....														23											23	
Idaho and Nevada.....																									(a)	
Illinois.....	32	7	7			15				2				63	2	2	2	1	5		2			5	73	
Indiana.....	6	6	2			2								13	1	1	1		3						16	
Iowa.....	13	1	1			5					1			18			1		1	1	1				25	
Kansas.....	8	1				1								6											16	
Kentucky.....	4	1												4											16	
Maryland.....	2	2												4											7	
Michigan.....																									16	
Missouri.....					2									11											11	
Montana.....	8		1																						(a)	
New Mexico.....																									11	
North Dakota.....	9	1	2	5				1						18											18	
Ohio.....	34	6	4			4	4	1						49			4		4	1					56	
Oklahoma.....	7	2	2	4		9		2						26								2	1	3	28	
Oregon.....																									28	
Pennsylvania (anthracite).....	183	32	57	28		35	4	5	7		41	387	11	1	4		16	17	13	1	10	17	58	461		
Pennsylvania (bituminous).....	140	23	38	29		7					4	246	3		2		5	1	2	2	2	2	2	7	258	
Tennessee.....	13		3			2								18											20	
Texas.....																									(a)	
Utah.....																									0	
Virginia.....																									(a)	
Washington.....	4	4	1	1	31	1	1				2	44											1	45		
West Virginia.....	51	15	12	3		4		3			1	89							2		1	1	2	6	95	
Wyoming.....																									(a)	
Total, 1899.....	560	100	141	98	33	93	5	12	7	2	56	1,107	21	4	16	3	44	24	18	4	17	27	90	1,241		

a No inspection, or report not published.

b Cumrock mine explosion, North Carolina.

TABLE 25.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1900, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.							Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, smothered, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
Alabama.....	17	2	4	2		3						9	37							17	18	19	20	21	22	
Alaska and California.....																										(a)
Arizona.....																										(a)
Arkansas.....																										(a)
California.....	19	6	2		1						1		29										1	1	2	(a)
Colorado.....																										(a)
Georgia and North Carolina.....																										(a)
Idaho and Nevada.....																										(a)
Illinois.....	48	10	12			18			1		1	1	91	3	1	4		8								102
Indiana.....	11					3			1				15	2				3					1			19
Iowa.....	17		5			2							24	2	1	1		4	1							28
Kansas.....	12					6					1		19	1	1			3								21
Kentucky.....	12	1	1			1						7	15	1				2								17
Louisiana.....																										(a)
Maryland.....																										(a)
Michigan.....	6					2							8			1		1						1	1	10
Minnesota.....	16		1			1							18			1		1								19
Montana.....	1	3	1			2							7					1								9
New Mexico.....	4	2				3							9													(a)
North Dakota.....																										(a)
Ohio.....	40	5	15	3		3							66	2				2								71
Oklahoma.....	9	1	2	11	5	4		1					33	2				2					1	2	3	35
Oregon.....																										(a)
Pennsylvania (anthracite).....	133	31	63	38		42	4				3	18	332	8	4	7		19	17	9	1	10	23	60	411	
Pennsylvania (bituminous).....	131	35	41	6		9	1	6		1	1	4	235	8	2	7		17	10	4		2		12	264	
Rhode Island.....																										(a)
Tennessee.....	8	1				1							10													10
Texas.....																										(a)
Utah.....	3			4	200	1						1	209													209
Virginia.....																										(a)
Washington.....	12	1	1	4			3				5	2	28											1	3	31
West Virginia.....	58	7	9	47		19			1				141											2	9	150
Wyoming.....																										(a)
Total, 1900.....	557	105	157	115	205	121	8	7	3	1	11	43	1,333	26	11	24		61	35		10	2	18	30	95	1,489

a No inspection, or report not published.



TABLE 26. — NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1901, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.		Other causes.	Total.		
Alabama.....	18	6	6	2	6	6					11	12	38	13	14	15	16		17	18	19	20	21	22	2	2	40
Alaska and California.....																											18
Arkansas.....												18	18														55
Colorado.....	25	3	8	2	8	1		1	1	1		2	52	1					1			2					2
Georgia and North Carolina.....																											(a)
Idaho and Nevada.....																											(a)
Illinois.....	52	8	12	1	19	4							92	3	2	6		11	1	1		1	2	4	107		
Indiana.....	11	1	3		4	2							16	2	2	3		15									24
Iowa.....	14	7	2		2	3							28	1	1	2		4	1			1					29
Kansas.....	4	4	2		4	4							7	1	2		2		4	2							11
Kentucky.....	5	2	5		4	4							1	17	2				2								12
Maryland.....													12	2													16
Michigan.....	2					4							16								1						17
Minnesota.....	10		1			5						2	2	6													15
Montana.....	3		1			4							2	2													(a)
New Mexico.....	6		2		3	2							15														64
North Dakota.....														60	1	1	8		10			2	1		2		57
Ohio.....	31	6	9	3	8	12	6	1	1			1	46	2	2			2									(a)
Oklahoma.....	12		7	8																							64
Oregon.....																											57
Pennsylvania (anthracite).....	175	39	67	30		54	5		3		3	41	417	18	5			23	16		26	1	11	19	73	513	(a)
Pennsylvania (bituminous).....	155	34	49	26	1	7		9	4	1		4	290	1		3		4	4		2	1	1		7	301	
Tennessee.....	16	1	3		20	1				1		1	43														43
Texas.....													8														(a)
Utah.....	4	3	1																								8
Virginia.....																											17
Washington.....	9	5	4	2		2					17		23	2	1			3	1						1	27	
West Virginia.....	70	12	14	11		9				1	1	4	122	1				1	8				1	1	10	133	
Wyoming.....				22							28		50														50
<b>Total, 1901.....</b>	<b>622</b>	<b>127</b>	<b>194</b>	<b>107</b>	<b>46</b>	<b>137</b>	<b>5</b>	<b>12</b>	<b>8</b>	<b>4</b>	<b>50</b>	<b>89</b>	<b>1,402</b>	<b>32</b>	<b>12</b>	<b>23</b>		<b>67</b>	<b>30</b>		<b>29</b>	<b>6</b>	<b>16</b>	<b>24</b>	<b>105</b>	<b>1,574</b>	

a No inspection, or report not published.

TABLE 27.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1902, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.							Killed on surface.							Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.		Total.			
Alabama.....	29		9		10								48							17	18	19	20	21	22		2	50	
Alaska and California.....																													(a)
Arkansas.....													13															13	
Colorado.....	37	5	2	8	14	3					2		71							2							2	73	
Georgia and North Carolina.....																													(a)
Idaho and Nevada.....																													(a)
Illinois.....	42	12	16		24	7							95	4	1	5		10									2	107	
Indiana.....	11		3		7								21														1	24	
Iowa.....	15	2	2		22	5							47														1	29	
Kansas.....	12	1	2		7		1						23	3	2			5									1	49	
Kentucky.....	11				6								18															1	28
Maryland.....	3	4	3										10															1	19
Michigan.....	5		1										8					2									1	11	10
Minnesota.....	.....	1	1										6															1	8
Montana.....	.....	1	1										12	1															12
New Mexico.....	.....	1	1										14																14
North Dakota.....	.....																												(a)
Ohio.....	53	5	13	3	2	9							83														2	86	
Oklahoma.....	10		8	4		5		1			10		40													2	42	42	(a)
Oregon.....	.....																												
Pennsylvania (anthracite).....	77	38	44	20	31				2				229	8	2	6		16		15		17	4	4	15	55	300		
Pennsylvania (bituminous).....	200	26	54	126		9		11	1	4			433	5	1	8		14		2	2	2	3	1	8	226			
Tennessee.....	17	1	5		200	3							226															(a)	
Texas.....	.....																												
Utah.....	5		2										7													1	1	8	
Virginia.....	.....																												(a)
Washington.....	7	5	5										30	1	1			2								1	2	34	
West Virginia.....	61	16	14	23		5		1					120	5				5		6					3	9	134		
Wyoming.....	.....												21															21	
Total, 1902.....	609	117	188	184	249	130	1	13	3	4	14	63	1,575	27	7	26		60	28	1	22	10	7	21	89	1,724			

a No inspection, or report not published.

TABLE 28.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1903, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or burst steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
Alabama.....	20	2	6	18	3	3						8	57							17	18	19	20	21	22	
Alaska and California.....																										
Arizona.....				11									11													
Colorado.....	26	5	2		1	4		1				1	40	2					2	2						2
Georgia and North Carolina.....																										
Idaho and Nevada.....																										
Illinois.....	68	7	20	10	40	19		1			1	1	146	2	2	3	1		8			1	1	1	2	4
Indiana.....	16	2	4	1	3	7		1					45	4	2	2		6	1							52
Iowa.....	19	2	3		7	3							24	3				2	3							27
Kansas.....	16	2	3		5	7					2	2	28	1		1		3	3							33
Kentucky.....	17	1			1	1					2	25	1	1				1	2		1					30
Maryland.....	17	1	5										10	1				1	1		1					12
Michigan.....	2					1						1	4	1					1			2	1			8
Missouri.....	10			3		3							17													17
Montana.....	4		1										5													5
New Mexico.....	10	1	1			7					3	22														22
North Dakota.....				4																						
Ohio.....	75	12	13	4	11	9		2		1	1	1	119	1	1	2		4	1							124
Oklahoma.....	10		3	13	4	9			1				40									2	2			42
Oregon.....																										
Pennsylvania (anthracite).....	169	40	70	25	58	1		1	6		4	27	400	22	1	3		26	29	22	2	2	10	29	92	518
Pennsylvania (bituminous).....	217	31	71	23	14	2		9	1	1	5		372	6	1	2		9	5	2	2	5	2	14	395	518
Tennessee.....	15		2		2	2		1					20						6							26
Texas.....																										
Utah.....	3	2				1						6														7
Virginia.....																										
Washington.....	10	4	6			2							22	1				1	1	1	1				2	25
West Virginia.....	79	20	13	2	3	7		2	1	1	2		130	1				1	12			1	1	2	16	147
Wyoming.....				169									169													169
<b>Total 1903.....</b>	<b>790</b>	<b>130</b>	<b>221</b>	<b>279</b>	<b>8</b>	<b>196</b>		<b>18</b>	<b>9</b>	<b>3</b>	<b>8</b>	<b>50</b>	<b>1,712</b>	<b>45</b>	<b>5</b>	<b>13</b>	<b>1</b>	<b>64</b>	<b>58</b>	<b>26</b>	<b>5</b>	<b>22</b>	<b>39</b>	<b>150</b>	<b>1,926</b>	

a No inspection, or report not published.



TABLE 29.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1904, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed on surface.															
	Total.										Total.															
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Shafts or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	
Alabama.....	34	4	7	26		3						9	83	13	14	15	16			17	18	19	20	21	22	
Alaska and California.....																										
Arkansas.....																										
Colorado.....	43	10	10		19	4		1				2	89	1		1			2	1			1		1	3
Georgia and North Carolina.....																										
Idaho and Nevada.....																										
Illinois.....	64	12	17			53		1				2	149	11		6			17		4	1	2			7
Indiana.....	13		6			9		1					29	2					4				1			1
Iowa.....	11	2	2		2	1	1						19		2	3			5							34
Kansas.....	15		2			11							28	1					3							31
Kentucky.....	16		1		5	3				1			17						1					2		20
Maryland.....	3	1				1							9						6					1		10
Michigan.....	2	1				1						1	11													6
Missouri.....	8					3							9													11
Montana.....	6	1	2																							9
New Mexico.....	5	1	1			1							8													8
North Dakota.....																										
Ohio.....	64	10	13			13	1	2		4		1	108	4	1	1			5	2			1	1	4	117
Oklahoma.....			7	3	10	3							27						2							29
Oregon.....																										
Pennsylvania (anthracite).....	172	66	71	30		69			6		6	40	460	29	9	2			40	33	19	4	10	29	95	595
Pennsylvania (bituminous).....	203	32	52	5	179	7		12		2	1	6	499	7	1	8			16	4	3	1	5	5	18	533
Tennessee.....	19		4		3	2							28													28
Texas.....																										
Utah.....	4		2									2	8			1			1							9
Virginia.....																										
Washington.....	5	2	2				1	3					30											1	1	31
West Virginia.....	93	13	16	2		3						2	132	2		2			4	10	1		1	1	43	149
Wyoming.....																										
Total, 1904.....	779	156	215	66	235	180	3	20	6	7	7	65	1,749	57	14	28			99	51	27	6	21	42	147	1,995

a No inspection, or report not published.

TABLE 30.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1905, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Killed underground.										Killed in shaft.						Killed on surface.									
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	(Coal-dust explosions including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco- motives.	(Other causes.	Total.
Alabama.....	31	3	8	19	112	4		1				9	187							17	18	19	20	21	22	
Alaska and California.....																										(a)
Arkansas.....	5					1						2	8													8
Colorado.....	35	6	8			4		4					57	2		1			3	2				3	5	65
Georgia and North Carolina.....																									(a)	
Idaho and Nevada.....																										
Illinois.....	66	15	19	51	25	25		2			6	2	186	5	1	5		11			2		3	1	6	203
Indiana.....	17		3	2	9	8						1	40	2	2	3			5				1		1	46
Iowa.....	24	1	4		5	5						1	35	1				1		1			1		1	37
Kansas.....	23		1		2	13							39	1				1		1			1		1	41
Kentucky.....	19		2		7	7							28					1		1			2		3	31
Maryland.....	11	2	1			1						3	9						1							15
Michigan.....	5					2							10	1				1								13
Missouri.....	7	1	1										8													13
Montana.....	5	2	1										7													7
New Mexico.....			2																							
North Dakota.....																										(a)
Ohio.....	71	7	16	1	3	8	1	6		4		1	110	1		2		3	2	2	1	4	1	5	13	126
Oklahoma.....	6	1	3	18									40										1	1	1	41
Oregon.....																										(a)
Pennsylvania (anthracite).....	243	51	82	34	62	5	2	2	2			28	509	29	1	12		42	13	31	3	10	33	93	644	
Pennsylvania (bituminous).....	259	40	66	23	13	18	2	9	2	2	6	3	443	5	1	2		8	5	1	1	1	10	6	24	475
Tennessee.....	18		2			7		1					28						1						1	29
Texas.....																										(a)
Utah.....	2	1	1									4	4	1				1					2		2	7
Virginia.....																										(a)
Washington.....	6	1	3			1						1	12					2	6		1		5	1	13	12
West Virginia.....	99	7	25	7	38	10			2		8	1	197			2										212
Wyoming.....				18									18													18
<b>Total, 1905.....</b>	<b>957</b>	<b>138</b>	<b>247</b>	<b>173</b>	<b>177</b>	<b>181</b>	<b>8</b>	<b>25</b>	<b>6</b>	<b>6</b>	<b>20</b>	<b>52</b>	<b>1,990</b>	<b>48</b>	<b>3</b>	<b>27</b>	<b>...</b>	<b>78</b>	<b>31</b>	<b>1</b>	<b>33</b>	<b>8</b>	<b>35</b>	<b>50</b>	<b>164</b>	<b>2,232</b>

a No inspection, or report not published.

TABLE 31.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1906, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.										Killed on surface.					Grand total.
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	
Alabama.	45	5	12	13		7		6				2	90							17	18	19	20	21	22	6
Alaska and California.																										
Arkansas.	6					4						3	13													13
Colorado.	37	7	2	34		4		1					85			1			2	2						2
Georgia and North Carolina.																										
Idaho and Nevada.																										
Illinois.	66	17	23	3	2	20						1	132	10	2	11			23			1	3	2		161
Indiana.	19	3	1			4							27	1		2			3				1			31
Iowa.	14	1	1			3							26	2					2				1			29
Kansas.	14	1	1			20							36	1					2			1				39
Kentucky.	17	3	2	1		4		1					28	2	1	2			5			2				39
Maryland.	2	1	2										5						1							6
Michigan.	7	1						1				1	4			1			1							5
Missouri.	12					2							14	1	1				2							16
Montana.	3	2						1					13						3							13
New Mexico.	10	1	2	10									23													23
North Dakota.																										
Ohio.	75	5	12	3	8	17		9	2				118	1	1	8			10	3						131
Oklahoma.	7		4	6		12							42	1					1							44
Oregon.																										
Pennsylvania (anthracite).	168	46	67	46		82	1	1	3			23	437	11	2	6		19	30	1	23	1	7	39	101	557
Pennsylvania (bituminous).	269	35	30	10		3	1	26	1	5		2	447	5	2	2	1	10	5	2	4	3	3	5	19	476
Tennessee.	20		3			3						2	28	1				1	1	2					3	32
Texas.																										
Utah.	4												4													4
Virginia.				35									35													35
Washington.	6	1	9					1					18					1	1	2		1			3	22
West Virginia.	108	12	18	26	66	5		6		1		1	243	7	1	2		10	12	2		2	2	8	24	277
Wyoming.																										
Total, 1906.	902	138	256	189	76	197	2	53	6	6	8	35	1,868	44	11	36	1	92	42	3	36	2	16	59	178	2,138

a No inspection, or report not published.



TABLE 32.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1907, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or steam pipes.		Railway cars and loco-motives.	Other causes.	Total.	
Alabama.....	21	3	11	5	57	3		2				52	154													154	
Alaska and California.....																											
Arkansas.....	7					2						4	13													13	
Colorado.....	51	5	9	1	25	2					7		100	2	1				3	1	1		1	1	4	107	
Georgia and North Carolina.....																										(a)	
Idaho and Nevada.....																										(a)	
Illinois.....	73	20	39	5		31		2	1			3	174	4	3	1			8		3		7		10	182	
Indiana.....	15	1	8	2		18			1			1	46	1					4						2	46	
Iowa.....	21	7	3	1	1	3							34	1					5				1	1	2	40	
Kansas.....	21	1	1	1		6							32	1					4				1	1	2	37	
Kentucky.....	11	1	4			7		1		1			25	3					3	1	1		2		4	32	
Maryland.....	2		1			2																				2	
Michigan.....	2		1			2						1	6						1							7	
Missouri.....	6		1			1																				8	
Montana.....	7	1	1										9						1							13	
New Mexico.....	12	1	5		11						3		32							2		2		2	4	34	
North Dakota.....																										(a)	
Ohio.....	95	3	17	3		4		10		3		5	140	1					1	3	1	2	3	4	13	154	
Oklahoma.....	15	2	2	4	3	12		1					39													39	
Oregon.....																										(a)	
Pennsylvania (anthracite).....	235	44	88	45		87	12	3	9		7	44	574	17	3	7			27	36	2	29	5	13	22	107	708
Pennsylvania (bituminous).....	271	37	105	37	239	17		24	1	4	1	7	743	12	2	12			26	11	4	1	3	11	30	799	
Tennessee.....	19	1	3	3		1		2					29							1					1	30	
Texas.....																										(a)	
Utah.....	3		1	1									5													5	
Virginia.....				11																							
Washington.....	10	1	2	10		5		3				1	32						11		3	1			5	37	
West Virginia.....	132	17	37	25	461	20		4	1	1		2	700	4	1				5	12			2	16	31	736	
Wyoming.....	7	10	6		2	1						3	29												1	30	
Total, 1907.....	1,036	154	344	154	802	221	12	52	13	9	18	123	2,938	46	10	30	...	86	70	4	44	10	36	54	218	3,242	

a No inspection, or report not published.

TABLE 33. - NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1908, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed on surface.																
	Killed underground.										Killed on surface.																
	Falls of roof (coal, rock, etc.).	Falls of face or pillar of coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	(Takes or skips, shafts or slopes.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	Grand total.	
Alabama.....	36	3	16	9		12		10				22	108	13	6	1	1		8	1	2		8		11	172	
Alaska and California.....																										108	
Arkansas.....	8					1						5	14	41	1	2			2	1					14	(a)	
Colorado.....	33	5	9	5		3			2			2	59	2									1		2	63	
Connecticut.....																										(a)	
Delaware.....																										(a)	
District of Columbia.....																										(a)	
Florida.....	61	21	27	3		38		1	1	1	1		153	6	1	1			2		1	2			11	172	
Georgia.....	10	3	6	1		10		1	1			3	41	1	2				2						45	(a)	
Idaho.....	16	3	4			3						3	26	2	1	2			3						45	(a)	
Illinois.....	22			1		6						5	35	1					1	2		1	1	1	1	36	
Indiana.....	15		3			7		1											1	2					4	(a)	
Iowa.....																										(a)	
Kansas.....																										(a)	
Kentucky.....																										(a)	
Louisiana.....																										(a)	
Maine.....																										(a)	
Maryland.....																										(a)	
Massachusetts.....																										(a)	
Michigan.....	4		1			1							5	5					1						6	(a)	
Minnesota.....	8		1			1							10	10					2						21	(a)	
Montana.....	3	4	2			1					9		19	1					1			1	1	1	2	24	
New Mexico.....	15	1	6			1							23	2								1			1	24	
New York.....	2												4													(a)	
North Dakota.....																										(a)	
Ohio.....	71	3	17	2		6		5		1	29	4	105	1	1				2	1			1	1	6	113	
Oklahoma.....	3					1		1					4												46	(a)	
Oregon.....																										(a)	
Pennsylvania (anthracite).....	285	49	90	55		94	3	1	5		40	4	572	15	5	4			24	29	1	39	8	14	82	678	
Pennsylvania (bituminous).....	256	36	75	9	154	6		20		4	2	533	4	1	11			16	13	1	2	1	2	3	22	571	
Tennessee.....	26	1				1		4	1				33												1	34	(a)
Texas.....																										(a)	
Utah.....	2		2										5												5	(a)	
Virginia.....																										(a)	
Washington.....	13	1	8	1				1				1	25												25	(a)	
West Virginia.....	121	30	39	1		59	11	10	3	1		277	10					10	12	4	2	1	4	1	23	310	
Wyoming.....	6	3	1			59	1					10	80												1	81	(a)
Total 1908.....	945	168	312	89	286	203	4	54	12	7	39	90	2,209	42	10	25			77	59	7	36	4	23	80	159	2,445

a No inspection, or report not published.

TABLE 34.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1909, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on surface.					Grand total.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).		Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	
Alabama.....	61	9	17	6	18	10	2	4				2	129													129	
Alaska and California.....				6	6							4	16													16	
Arkansas.....	9					2							15													15	
Colorado.....	56	7	7	12	3	3		1				89	1	2					3	1		1	1	2	5	97	
Georgia and North Carolina.....	2												2													2	
Idaho and Nevada.....																											
Illinois.....	53	22	20	45		31		3	2		259	2	440						7			2	1	5	3	11	
Indiana.....	23	2	4		6	5				1		1	42	2	1	3			6							49	
Iowa.....	23	4	5			2	2	1				1	31	1					1							39	
Kansas.....	18			3		8			1				31						1							32	
Kentucky.....	20	1	2	7		2		1		1			33						1							34	
Michigan.....	11	1	1										13						1							20	
Minnesota.....	10	4				1		1				1	18	1		2			3							21	
Missouri.....	6	2	2			1							11						1							11	
Montana.....	5	4	3			1					2		14													14	
New Mexico.....																											
North Dakota.....	66	2	21	1	2	9		2		2		6	105	1					1	2						110	
Ohio.....	6		6	15	4	10							47													48	
Oklahoma.....																											
Oregon.....	195	59	71	31		69	1	6	6		12	30	480	7	1	2			10	23	21	3	3	27	77	567	
Pennsylvania (anthracite).....	250	39	83	9	41	7		22	1	1	3	6	462	7	2	4			13	10	6	6	3	6	25	500	
Pennsylvania (bituminous).....	18				3								27						1							29	
Tennessee.....	4							2												1						4	
Texas.....	7	6	2										15													15	
Utah.....	16																									16	
Virginia.....	9	4	1	14		3		4				11	27													27	
Washington.....	142	30	52	4	67	14						3	37						1	6	2	1				39	
West Virginia.....	11	9	5			4		11				3	323	1					1	1	2					336	
Wyoming.....													29													30	
Total, 1909.....	1,025	204	307	153	142	191	5	58	10	5	276	69	2,445	20	6	21			47	50	2	31	4	16	47	150	2,642

a No inspection.



TABLE 35.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1910, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.				Killed on surface.							Grand total.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Ages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.		
Alabama.....	51	4	20		139	10		6				7	237							17	19	19	20	21	22	1	238	
Alaska and California.....																										0	14	
Arkansas.....	10					4							14													3	323	
Colorado.....	62	11	18	79	131	5					10	2	318	2					2	1	1	1				3	323	
Georgia and North Carolina.....																										0	0	
Idaho and Nevada.....																										0	0	
Illinois.....	61	13	28	8		9		1	5				125	4	3	6	13		13		1	3	1			5	143	
Indiana.....	25		6	4		11							47	2		2		4		4						51	51	
Iowa.....	20	1	3			3		1	1			1	29	3				3	1							33	33	
Kansas.....	7		1		1								12	4				4		1						1	17	
Kentucky.....	20	1	5		40	16		2					85					1								86	86	
Maryland.....	9	2	1			1							15					1		2						18	18	
Michigan.....	4		1			1							6					1								6	6	
Missouri.....	8		3			1							14													14	14	
Montana.....	4		3										12													12	12	
New Mexico.....	1												16													16	16	
North Dakota.....	8	46	1			1							2													2	2	
Ohio.....	94	7	16	16		5		7		2			147	1		2	3	5		3	5	1	1	2		9	159	
Oklahoma.....	11		3		13	3						1	31					3	5							3	39	
Oregon.....																										0	0	
Pennsylvania (anthracite).....	173	80	93	20		82	13	3	1			21	489	11		8	1	20	41	29	1	21			92	601	601	
Pennsylvania (bituminous).....	261	47	105	15		10		30	1	2		2	473	9	3		12	11	2	6	5	4	8	1		36	521	
Tennessee.....	22		3			10		2					37						12	11	2	6			1	38	38	
Texas.....	4		1					1				1	7							1						3	7	
Utah.....	6	4	3			1						1	15					3		3					3	18	18	
Virginia.....	35		1		10			3		3		2	54					1		1					3	57	57	
Washington.....	8		2		18	4						2	41					1		1					2	43	43	
West Virginia.....	173	31	55	3			8	20	1	4		2	296	3	11		14	15		15			1	1	3	19	329	
Wyoming.....	15	10	3			6						1	35													1	36	36
Total, 1910.....	1,092	222	380	145	352	195	13	79	9	11	10	49	2,557	39	3	34	4	80	83	2	40	9	12	38	184	2,821	2,821	

TABLE 36.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1911, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.				
	Falls of roof (coal, rock, etc.).		Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.
	1	2	3	4	5	6	7	8	9	10	11	12	Total.	13	14	15	16	Total.	17	18	19	20		21	22	Total.	
Alabama.....	43	4	14	2	128	5	.....	6	.....	.....	.....	2	204	1	.....	.....	.....	.....	.....	.....	.....	.....	2	2	4	209	
Alaska and California.....	9	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12		
Arkansas.....	40	6	10	.....	17	2	2	2	.....	.....	2	2	81	2	2	.....	.....	.....	.....	.....	.....	.....	1	3	5	88	
Colorado.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0		
Georgia and North Carolina.....	66	17	41	9	.....	15	1	3	1	.....	.....	1	154	5	7	.....	.....	.....	.....	.....	.....	.....	1	1	3	172	
Idaho and Nevada.....	17	2	4	1	2	11	1	2	.....	.....	.....	.....	40	3	.....	.....	.....	.....	.....	.....	.....	.....	1	1	1	46	
Illinois.....	20	.....	.....	7	3	3	3	1	1	.....	.....	3	35	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	38		
Indiana.....	28	5	2	.....	.....	4	.....	3	1	.....	.....	3	40	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	42		
Iowa.....	12	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	41	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44		
Kansas.....	3	1	.....	.....	.....	.....	.....	2	.....	.....	.....	1	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15		
Kentucky.....	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8		
Maryland.....	9	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14		
Michigan.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11		
Minnesota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	105	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1		
Montana.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1		
New Mexico.....	78	8	11	.....	.....	3	3	3	.....	2	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	107		
New York.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27		
North Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1		
Ohio.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1		
Oklahoma.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1		
Oregon.....	195	57	92	34	.....	88	14	2	.....	.....	.....	.....	594	17	4	.....	.....	21	26	1	22	1	34	84	699		
Pennsylvania (anthracite).....	248	60	90	21	8	6	.....	39	2	.....	72	12	486	3	1	.....	.....	4	12	1	4	3	.....	5	515		
Pennsylvania (bituminous).....	14	.....	.....	.....	84	1	.....	4	.....	.....	.....	.....	108	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	111		
Tennessee.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8		
Texas.....	5	5	.....	1	.....	2	.....	.....	.....	.....	.....	.....	12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13		
Utah.....	35	.....	18	5	.....	.....	.....	2	.....	.....	.....	.....	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4		
Virginia.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8		
Washington.....	6	4	8	.....	.....	2	.....	2	.....	.....	.....	.....	23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27		
West Virginia.....	164	28	55	18	23	2	.....	22	1	4	.....	3	321	2	.....	.....	.....	2	10	3	2	.....	.....	1	341		
Wyoming.....	15	9	4	1	.....	1	.....	.....	.....	.....	.....	1	31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32		
Total, 1911.....	1,053	206	382	99	268	160	20	94	7	9	75	63	2,434	34	16	2	52	61	5	31	7	12	54	170	2,656		

TABLE 37.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1912, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on surface						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
Alabama.....	56	6	15	26	.....	5	.....	8	.....	.....	.....	1	117	2	1	.....	.....	3	.....	.....	.....	.....	3	.....	3	123
Alaska and California.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Arkansas.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
Colorado.....	43	9	13	15	2	1	1	6	1	.....	.....	3	93	.....	.....	1	1	1	1	1	.....	.....	1	.....	.....	96
Georgia and North Carolina.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Idaho and Nevada.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Illinois.....	65	19	41	3	.....	11	.....	2	2	1	.....	.....	144	6	1	5	.....	12	1	1	.....	1	3	2	7	163
Indiana.....	20	8	8	2	2	2	.....	.....	.....	.....	.....	.....	34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
Iowa.....	9	2	3	.....	2	3	.....	.....	.....	.....	.....	.....	19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
Kansas.....	13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
Kentucky.....	19	1	2	5	5	1	.....	1	1	.....	.....	.....	42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51
Maryland.....	8	4	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
Michigan.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Missouri.....	7	2	2	2	1	2	.....	2	.....	.....	.....	.....	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
Montana.....	2	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
New Mexico.....	8	2	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
North Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Ohio.....	91	8	16	2	.....	5	.....	2	.....	1	.....	4	129	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	135
Oklahoma.....	6	1	3	75	2	1	.....	.....	.....	.....	.....	.....	99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	99
Oregon.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Pennsylvania (anthracite).....	166	77	79	35	1	.....	.....	.....	.....	.....	.....	.....	476	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	601
Pennsylvania (bituminous).....	266	43	106	1	.....	77	5	5	.....	.....	.....	30	476	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	446
Tennessee.....	13	1	2	.....	.....	8	.....	18	1	.....	.....	17	400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
Texas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
Vermont.....	5	9	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
Virginia.....	33	9	9	10	.....	10	.....	.....	.....	.....	.....	.....	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	75
Washington.....	3	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
West Virginia.....	176	18	45	5	83	8	.....	21	.....	.....	.....	.....	361	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	381
Wyoming.....	16	5	5	.....	7	.....	.....	.....	.....	.....	.....	.....	84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36
Total, 1912.....	975	211	371	185	105	147	6	80	6	7	11	55	2,159	33	5	20	3	61	78	8	33	5	14	61	139	2,419



TABLE 38.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1913, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed on the surface.															
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	Total.	Grand total.
Alabama.....	61	7	19	3	13	2	11	5				2	123												1	124
Alaska and California.....						1							1												1	1
Arkansas.....	5	1	1		2	1					1		11												1	12
Colorado.....	46	1	7		37	4	3	2	1	3		1	105												1	108
Georgia and North Carolina.....	3												3													3
Idaho and Nevada.....																										0
Illinois.....	59	21	38	8		11	1	8	1	1	1	5	153	2	1	1			4		1	1	2	3	7	164
Indiana.....	24	5	8	7	8	4		1	1			26	99	2					5	1					1	2
Iowa.....	16		6		1	1						1	26												1	26
Kansas.....	17					1							25												1	26
Kentucky.....	24	1	1	1	2	1	6.5	4	1	2		4	43	2					2					2	3	48
Maryland.....	6		3			2						1	12						1					1	1	13
Michigan.....	2												2						1							3
Minnesota.....	8												1						1							9
Montana.....	9	4	2			1						1	17						1				2		10	20
New Mexico.....	3	1	2		261	2	2					1	272						1						2	272
North Dakota.....	3											6	6						4							6
Ohio.....	90	3	32	15		1		9		2		2	159	3					4				1	1	2	165
Oklahoma.....	7		6	2	1	4		2				22	121						4						2	23
Oregon.....																										0
Pennsylvania (anthracite).....	192	65	85	50		75	11	1	4	4		36	523	30					30	35	1	15			14	65
Pennsylvania (bituminous).....	257	56	102	97		4		23		6		9	554	7					7	26	5	6			11	609
Tennessee.....	20	5	6					1					34						26						1	48
Texas.....	2	1										1	1	1					4						1	35
Utah.....	3					1						1	11	1					1	3	1				5	17
Virginia.....	11	1	4					4				1	3	24					1				1		5	24
Washington.....	17		4			1						1	21						1						2	22
West Virginia.....	170	30	86	5	1	2		17		6		2	319	1					10	1	2			3	16	337
Wyoming.....	13	2	4			8		2					24						2						3	26
Total 1913.....	1,060	204	424	91	423	138	33	80	9	24	4	72	2,562	50	1	9	2	62	78	8	26	1	8	40	161	2,785

<sup>a</sup> Fatality in mine employing less than 10 men.<sup>b</sup> Suffocated by entering an abandoned mine.

TABLE 39.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1914, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.					Killed on the surface.								Grand total.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosion or bursting steam pipes.	Railway cars and loco-motives.		Other causes.	Total.
Alabama.....	53		24	37		1		11		1			127										1		1	128
Alaska and California.....																										0
Arkansas.....	3		3	2	1	1							10											1	11	11
Colorado.....	40	2	13	1		4		6		2		4	71			1								2	2	75
Georgia and North Carolina.....	1												1												1	1
Illinois and Nevada.....																										0
Indiana.....	49	20	38	55		9		2		2			176	4	2	1	1					2	3	4	9	193
Iowa.....	18	3	4	2		6		2		1		2	40	3	2								2		2	44
Kansas.....	14		5		5	3	1						32	3	2										37	37
Kentucky.....	30		13		8	1		1					25	6	1							1			1	33
Maryland.....	15	1	1		1	6		2		1			53	2								1	1	1	6	61
Michigan.....													17												1	18
Missouri.....	12									1			14	2		5									1	19
Montana.....	16		2										16	1											1	18
New Mexico.....	14		2																						1	3
North Dakota.....	1																									3
Ohio.....	44	1	10	1	1	2		3		2		1	62	3									1	1	2	64
Oklahoma.....	20		3	1		2		3		3		1	31												1	31
Oregon.....													1													3
Pennsylvania (anthracite).....	166	62	76	44		90	8	3	2	1	34	486	47	4								1	18	62	595	
Pennsylvania (bituminous).....	189	44	89	3		7	5	25	1	3	10	376	3	3								3	4	2	402	
Tennessee.....	19	2	1	1		1							24	1											2	26
Texas.....	4	2	1	1		1					1	1	10	1											1	11
Utah.....	9		6					1		1			17	1	1							2	1		5	22
Virginia.....	12	1	1					1					15												10	27
Washington.....	6	2	3	1		3		1					16	2											1	17
West Virginia.....	220	73	182			5		29	2	5	5	3	524	2	1	1						1	4	11	28	586
Wyoming.....	22	5	9			4		1	1				43												8	51
Total 1914.....	985	146	380	332	17	146	14	89	7	20	7	57	2,200	70	5	12	1	88	68	11	26	5	13	43	166	2,454

**CUSTOMARY BASIS FOR COMPUTING FATALITY RATES.**

The customary basis for computing fatality rates is on the number of men employed in the industry. This basis is faulty to the extent that under existing conditions it is not possible to obtain the exact number of men at work, for the reason that all of the men do not work throughout the year. There are always a number of men who work a few days at one property and either quit or are discharged and go to other mines. The actual number of men on the pay roll is, therefore, much higher than the number of men really at work in the mines, and unfortunately it is the former figure that the operators too frequently report. It is also imperfect in that no distinction is made concerning the number of working hours per day. In some States the 8-hour day prevails, whereas in others 9 or 10 hours constitute a legal day.

The comparison of fatality rates on a percentage basis is far from being correct. For example, there may be 1,000 fatalities due to various causes in a certain group of mines, 50 per cent of which may be attributed to some one cause, as falls of rock, and 25 per cent to some serious gas and dust explosion. The difficulty with the percentage basis is that the number killed in a large disaster enters into the total number of men killed in that particular group of mines. When the total is thus abnormally increased the effect is to decrease the percentage rate of each of the other causes to balance the excess which is due to the one large disaster. In the assumed case above cited, in which 25 per cent of the fatalities were due to a gas and dust explosion, the elimination of the number killed (250) in this particular disaster from the total would leave only 750 fatalities, and the percentage of fatalities due to falls of rock, which in the first case was 50 per cent, would be increased to 66 $\frac{2}{3}$  per cent, although the actual number, 500, killed by falls of rock remains the same, and roof conditions have not changed.

The tonnage basis for comparison is also open to some criticism in that mining conditions are not the same in all mines or States. One mine may be in a coal bed 7 or 8 feet thick, and another mine in a bed 2 feet 6 inches thick. It is evident that a miner working in thick coal can produce more tons per year than a miner working in thin coal. The first mine would show a lower fatality rate on the tonnage basis, although in each mine the men were exposed to the mining risk the same number of days per year, indicating that the thicker coal bed is safer than the thinner bed. As a matter of fact the thinner coal bed is the safer of the two, as shown by the low fatality rate in Iowa as compared with the rates of Illinois and Indiana and some other States.

For certain purposes, each method has its champion, and in order to meet the requirements of all, the three bases have been used throughout this bulletin. But for true hazard rates, that one serves



best which takes into account the number of men and the time they are engaged in a hazardous occupation. This necessitates reducing all labor to a standard year of a certain number of hours, 2,000 or 3,000 as the case may be, representing a definite number of days (shifts) of 8 or 10 hours each. The ideal method would be for the operators to report the actual number of hours' labor for which wages were paid during the year. This figure divided by 2,000 would give the number of 2,000-hour employees; that is, the actual number of men who were exposed to the mining hazard the full 2,000-hour period. They would, therefore, all be on the same time basis. The total number of hours divided by 3,000 would place the employees on a 300 (10-hour) day year, but inasmuch as coal mines are operated less than 2,000 hours per year, the shorter year is more nearly in keeping with actual conditions, and therefore preferable. Figures approximating this condition are given in Tables 40 and 41.

TABLE 40.—FATALITY RATES BASED ON THE NUMBER OF 2,000-HOUR WORKERS AS COMPARED WITH THE RATE BASED ON THE NUMBER OF MEN REPORTED AS EMPLOYED, 1903-1913, INCLUSIVE, EXCEPT 1909.

[See Plate III.]

State.	Days worked per year (10-hour).	Actual number of men employed (10-year period).	Number of 2,000-hour workers.	Fatalities for 10-year period.			Fatalities per 1,000 men.					
				Exceptional accidents.	Common accidents.	Total.	Exceptional.		Common.		Total.	
							Actual employees.	2,000-hour workers.	Actual employees.	2,000-hour workers.	Actual employees.	2,000-hour workers.
Alabama.....	225.5	211,382	238,316	474	905	1,379	2.24	1.98	4.28	3.80	6.52	5.78
Arkansas.....	131.4	a 39,003	24,611	.....	92	92	.....	.....	2.36	3.74	2.36	3.74
Colorado.....	217.2	123,713	134,371	367	710	1,077	2.97	2.73	5.74	5.29	8.71	8.02
Illinois.....	153.7	664,866	521,053	116	1,585	1,701	.17	.22	2.38	3.04	2.55	3.26
Indiana.....	148.7	209,054	155,453	16	442	458	.08	.10	2.12	2.85	2.20	2.95
Iowa.....	170.4	157,415	134,128	.....	305	305	.....	.....	1.94	2.27	1.94	2.27
Kansas.....	153.4	124,576	97,430	12	324	336	.10	.12	2.60	3.33	2.70	3.45
Kentucky.....	188.5	187,589	176,793	79	339	418	.42	.45	1.81	1.91	2.23	2.36
Maryland.....	242.8	a 47,611	57,957	.....	104	104	.....	.....	2.18	1.79	2.18	1.79
Michigan.....	162.0	35,454	28,725	.....	65	65	.....	.....	1.83	2.26	1.83	2.26
Missouri.....	153.9	95,056	73,154	.....	124	124	.....	.....	1.30	1.70	1.30	1.70
Montana.....	193.0	29,887	28,840	17	105	122	.57	.59	3.51	3.64	4.03	4.23
New Mexico.....	246.3	29,776	36,069	289	144	433	9.70	7.88	4.84	3.93	14.54	11.81
North Dakota.....	197.4	b 3,188	3,244	.....	13	13	.....	.....	4.08	4.01	4.08	4.01
Ohio.....	149.5	452,089	337,891	35	1,296	1,331	.07	.10	2.87	3.84	2.91	3.94
Oklahoma.....	140.6	84,418	63,009	150	279	429	1.77	2.38	3.31	4.46	5.08	6.81
Pennsylvania (anthracite).....	198.5	1,668,725	1,655,961	240	5,979	6,219	.14	.14	3.59	3.62	3.73	3.76
Pennsylvania (bituminous).....	203.4	1,573,200	1,599,843	838	4,502	5,340	.53	.52	2.86	2.82	3.39	3.34
Tennessee.....	210.0	112,247	117,869	84	297	381	.75	.71	2.65	2.52	3.40	3.23
Texas.....	210.1	c 19,405	20,043	.....	21	21	.....	.....	1.08	1.05	1.08	1.05
Utah.....	210.9	25,084	26,451	.....	104	104	.....	.....	4.15	3.93	4.15	3.93
Virginia.....	244.7	c 33,211	42,553	26	198	224	.78	.61	5.96	4.65	6.74	5.26
Washington.....	202.3	55,641	56,290	66	192	258	1.19	1.17	3.45	3.41	4.64	4.58
West Virginia.....	213.2	582,525	620,895	839	2,380	3,219	1.44	1.35	4.09	3.83	5.53	5.18
Wyoming.....	213.7	b 39,171	36,982	65	146	211	1.66	1.76	3.72	3.95	5.38	5.71
Total and average.....	190.9	6,604,289	6,288,531	3,713	20,652	24,365	.56	.59	3.13	3.28	3.69	3.87

a Employees and fatalities for 8 years only.

b Employees and fatalities for 5 years only.

c Employees and fatalities for 4 years only.

TABLE 41.—FATALITY RATES PER 1,000 MEN, BY STATES, COMPARED ON A UNIFORM BASIS OF 2,000-HOUR WORKERS.<sup>a</sup>

State.	1903	1904	1905	1906	1907	1908	<sup>b</sup> 1909	1910	1911	1912	1913	Average.
Alabama.....	2.47	4.58	8.91	4.15	6.23	5.30	.....	8.82	8.77	4.62	4.07	5.78
Arkansas.....	.....	.....	2.09	4.58	3.35	4.52	.....	4.88	4.21	2.09	3.71	3.74
Colorado.....	3.98	9.40	4.99	6.49	6.28	4.43	.....	18.78	6.48	7.13	9.74	8.02
Illinois.....	3.40	3.70	4.33	3.37	3.32	3.40	.....	3.06	3.02	2.18	2.72	3.26
Indiana.....	3.86	2.44	2.99	2.10	3.15	3.51	.....	2.53	3.01	2.21	3.89	2.95
Iowa.....	2.08	1.87	2.89	2.11	2.78	2.24	.....	2.26	2.76	1.54	2.11	2.27
Kansas.....	3.47	2.96	4.01	4.04	3.26	3.73	.....	2.22	4.63	3.17	2.84	3.45
Kentucky.....	1.98	1.56	2.30	2.64	1.97	2.73	.....	4.19	1.98	2.26	1.86	2.36
Maryland.....	1.94	1.59	2.02	.....	.....	.....	.....	2.30	2.05	1.89	1.88	1.79
Michigan.....	3.04	2.24	3.23	1.82	1.88	1.71	.....	1.98	2.47	3.51	1.21	2.26
Missouri.....	2.06	1.31	1.56	2.23	1.10	1.13	.....	2.32	1.14	2.33	1.28	1.70
Montana.....	2.08	3.38	3.67	5.53	4.43	7.38	.....	3.24	4.12	2.31	6.60	4.23
New Mexico.....	9.77	3.85	2.87	9.32	8.65	7.16	.....	3.18	2.10	2.99	49.26	11.81
North Dakota.....	.....	.....	.....	.....	.....	7.55	.....	3.83	1.22	.....	8.78	4.01
Ohio.....	3.78	3.82	4.11	4.30	4.11	3.18	.....	4.18	3.28	3.67	4.37	3.94
Oklahoma.....	5.44	4.27	7.04	7.97	5.33	7.67	.....	7.80	4.92	16.01	3.21	6.81
Pennsylvania (anthracite).....	3.71	4.24	4.02	3.91	4.28	4.33	.....	3.44	3.63	3.32	3.04	3.76
Pennsylvania (bituminous).....	2.96	4.66	3.25	3.15	4.45	3.97	.....	2.89	2.99	2.48	3.07	3.34
Tennessee.....	2.46	2.69	2.37	2.62	2.35	3.01	.....	3.06	9.23	1.10	2.78	3.23
Texas.....	.....	.....	.....	.....	.....	.....	.....	1.62	1.63	.....	.71	1.05
Utah.....	3.29	5.56	5.20	2.21	2.18	2.06	.....	5.67	3.94	5.01	3.73	3.93
Virginia.....	.....	.....	.....	.....	.....	.....	.....	6.67	6.53	6.93	1.88	5.26
Washington.....	3.92	5.87	2.67	4.52	5.66	5.54	.....	6.63	4.03	2.79	3.65	4.58
West Virginia.....	3.55	3.33	4.43	5.16	11.40	6.09	.....	4.35	4.77	4.34	4.07	5.18
Wyoming.....	.....	.....	.....	.....	.....	13.46	.....	4.55	4.18	4.49	3.36	5.71
Average.....	3.31	3.97	3.91	3.72	4.87	4.28	.....	4.03	3.78	3.32	3.58	3.87

<sup>a</sup> For details from which this table is derived see special tables under each individual State.<sup>b</sup> Complete data not available.**COMPARISON OF FATALITY RATES ON A UNIFORM TIME BASIS.**

In the comparison of mine accidents the time element should be taken into consideration. In other words, the length of time that a man is exposed to the mining risk is an important factor in arriving at the true risk in the mining industry, and especially so when one State is compared with another. With this end in view, Tables 40 and 41 are based upon a uniform period of two hundred 10-hour shifts.

The tables under the various States show the number of 8, 9, and 10 hour men over a period of 10 years. There are also a number of men unclassified, but for this comparative study they have been taken as 9-hour men. Concerning the actual number of working hours E. W. Parker says: <sup>a</sup>

It should be remembered, however, that when the length of the working day is stated, reference is made to the number of hours the mines are supposed to have been in operation and not to the number of hours worked by the miners. In both the anthracite and bituminous fields practically all the coal is mined by contract at an agreed rate per ton or other basis of payment. The miner is an independent contractor and is not obliged to put in a certain number of hours at his working place. The figures in the following table really indicate the number of hours the men were given an opportunity to work and do not mean that all the employees worked 8, 9, or 10 hours, as the case might be.

<sup>a</sup> Mineral Resources of the United States for the calendar year 1913, U. S. Geol. Survey, 1915, p. 754.

Since the settlement of the anthracite strike of 1902 the mines in that region have been operated on a 9-hour basis, with the exception of engineers and pumpmen, who work 8 hours, and of the miners, who work by contract.

While these figures as previously stated, may not be strictly exact, it is certain that in an 8-hour State there will not be many 10-hour men. Yet it is believed that in a 10-hour State the majority of the men will work about two hours longer than in an 8-hour State. Inasmuch as these labor statistics were all collected by one bureau, the United States Geological Survey, they are all on the same basis, and for comparative purposes should serve nearly as well as exact figures. They are the only figures available by which it is possible to attempt a study of mine accidents in relation to the length of exposure to the many dangers attending the industry.

Exact data along these lines are desirable; and it is hoped that mining companies, State officials, and industrial-accident commissions will realize the importance of arriving at a true risk and cooperate in obtaining such information as may reveal the true accident hazard in the mining industry.

The State tables (see list of States in Tables 40 and 41) cover a 10-year period from 1903 to 1913 inclusive, except for the year 1909, for which complete data are lacking. This information is available for 24 States, and the varying hours, number of employees, and the working days have been given proper weight, with the result that the total number of working hours in each State has been computed for the 10-year period, and their sum gives the total number of working hours in all the States. This divided by the number of men reported working gives an average year of 1,909 hours for the United States as a unit. The working hours in each State divided by 2,000 gives the equivalent of 2,000-hour workers, upon which fatality rates may be based. The number of calculated 2,000-hour workers is given in parallel with a column showing the number of employees as reported.

Table 40 shows the number of working hours per year in each State as varying from 1,314 in Arkansas to 2,447 in Virginia. The Pennsylvania anthracite field works 1,985 and the Pennsylvania bituminous 2,034 hours per year. In view of the fact that this range varies from a few hours below to a few hours above 2,000, and that the average for the United States is 1,909, a 2,000-hour year has been adopted for calculations in the accompanying tables. It is more nearly in keeping with actual mining conditions to base the calculations on a 2,000-hour year than it would be to base them on a 3,000-hour year, as is frequently done in factories, metallurgical works, and in other industrial plants. Anyone desiring a 3,000-hour basis may obtain it by adding 50 per cent to all of the rates given in Tables 40 and 41.

Table 40 gives the number of fatalities that are due to *exceptional accidents* and those due to *common accidents*, the exceptional acci-



dent being one in which five or more men are killed at a time, and the common accident one that occurs in every-day mining operations, wherein usually one or two men but not more than four, may be involved at a time.

The length of time during which miners are exposed to the hazards of the industry varies in different States, due to both commercial requirements and labor organizations. The number of hours a day is largely regulated by labor organizations and State laws, and the number of days worked a year is regulated more or less by commercial conditions. When the demand for coal is slight the output is curtailed by working part of the time, or by closing the mines entirely for several weeks to await better market conditions.

The actual average number of days that the mines are operated each year is given in the State tables. The tables show that this number varies from year to year for the same State. For example, in 1906 Colorado averaged 268 working days, while in 1911 the mines were operated 207 days. Arkansas in 1903 operated 223 days, and in 1910 only 128 days. Ohio varied from 161 days in 1908 to 206 days in 1913. With such wide differences in the number of days that the mines are in operation, it is evident that the hazards in each State are not the same.

Another reason why they are not comparable is that the number of hours worked per day is not the same in each State. For example, Ohio, Indiana, Illinois, Iowa, and a number of other States are on an 8-hour basis with but few 9-hour and 10-hour men. On the contrary, in Alabama, Kentucky, West Virginia, Maryland, and a few others, the majority of the men work 9 hours and many of them 10 hours, as shown in the State tables.

It is not a fair classification to place the fatality rate of an 8-hour State on an equal basis with that of a 10-hour State, when the men of the latter State are exposed to the mining risk 25 per cent longer. Every hour adds  $12\frac{1}{2}$  per cent to the hazard, as compared with an 8-hour day. As an example of unfair comparison Ohio and Montana may be cited. The fatality rate for Ohio (Table 40) is 2.94 per 1,000, based on the actual number of men working, regardless of the time element, and the rate for Montana is 4.08 per 1,000. When the rates are reduced to a common basis of 2,000 working hours a year, the Ohio rate becomes 3.94 and the Montana rate 4.23, so that the difference on the 2,000-hour basis is 0.29, as compared with 1.14 per 1,000 on the customary basis. The same comparison may be made for other States. In Virginia many of the mines are worked 10 hours a day and from 200 to 280 days per year, thus increasing the time of exposure and giving on the customary basis a fatality rate of 6.74, which, if reduced to the 2,000-hour year, becomes 5.26, comparing favorably with West Virginia at 5.18 per 1,000.

Table 41 shows the fatality rate by States and calendar years, for a 10-year period wherein all rates are based on the number of 2,000-hour workers. The detail figures from which this table is derived will be found in the special tables in Part II under each individual State.

Plate III shows comparative fatality rates at the coal mines of the States in which coal is produced, based on a uniform period of 2,000 working hours per year, thus placing all of the States on a comparable basis, as indicated in Table 40. The circles represent the fatality rate per 1,000 men employed, wherein only the "common accidents" are considered. The solid circles represent the fatality rate per 1,000 men employed, for the "exceptional accidents." This chart represents the average of each State for a 10-year period, except where noted in Table 40. The common-accident hazard varies somewhat from one State to another, yet the difference is much smaller than usually shown where the time element is not taken into consideration.

### PRINCIPAL CAUSES OF MINE ACCIDENTS.

#### COAL-MINE DISASTERS.

A summary of the coal-mine accidents in the United States in which 5 or more men were killed at one time, together with the number of such accidents, is given in Table 42. This table shows that since 1839 there have been 297 mine disasters in which 5 or more men were killed at one time, representing 7,590 fatalities. Of this number, 6,126 were killed by gas and dust explosions, 199 of the disasters falling into this class. There were 30 mine fires, claiming 809 victims. There were 144 accidents in which 5 to 9 men were killed at one time, representing 911 fatalities. Although this group represents the greatest number of accidents, the largest number of men killed is in that group in which from 100 to 199 fatalities resulted from a single disaster. There were 12 such disasters, resulting in 1,715 fatalities. Details relating to individual accidents classified in this table are given in Table 44.





TABLE 43.—FATALITIES IN AND ABOUT THE COAL MINES OF THE UNITED STATES CLASSIFIED ACCORDING TO COMMON AND EXCEPTIONAL ACCIDENTS.<sup>a</sup>

[See fig. 4.]

Year.	Number killed.			Number killed per 1,000 employed.		
	In ex- ceptional accidents.	In com- mon accidents.	Total.	In ex- ceptional accidents.	In com- mon accidents.	Total.
1870.....	21	190	211	0.59	5.34	5.93
1871.....	25	185	210	.67	4.93	5.60
1872.....	.....	223	223	.....	4.98	4.98
1873.....	10	253	263	.21	5.25	5.46
1874.....	.....	260	260	.....	3.87	3.87
1875.....	.....	260	260	.....	3.06	3.06
1876.....	.....	242	242	.....	2.83	2.83
1877.....	14	211	225	.17	2.60	2.77
1878.....	5	230	235	.06	2.56	2.62
1879.....	11	306	317	.12	3.18	3.30
1880.....	5	269	274	.04	2.17	2.21
1881.....	.....	340	340	.....	2.93	2.93
1882.....	5	443	448	.03	2.72	2.75
1883.....	79	463	542	.49	2.85	3.34
1884.....	40	498	538	.21	2.59	2.80
1885.....	52	497	549	.25	2.33	2.58
1886.....	65	429	494	.30	1.95	2.25
1887.....	10	494	504	.04	2.16	2.20
1888.....	83	645	728	.29	2.26	2.55
1889.....	20	648	668	.07	2.29	2.36
1890.....	78	655	733	.27	2.25	2.52
1891.....	141	815	956	.46	2.62	3.08
1892.....	170	821	991	.53	2.59	3.12
1893.....	53	905	958	.15	2.55	2.70
1894.....	77	881	958	.21	2.46	2.67
1895.....	191	951	1,142	.51	2.53	3.04
1896.....	133	950	1,083	.35	2.50	2.85
1897.....	52	938	990	.14	2.41	2.55
1898.....	28	1,034	1,062	.07	2.64	2.71
1899.....	88	1,153	1,241	.23	2.91	3.14
1900.....	273	1,216	1,489	.63	2.81	3.44
1901.....	140	1,434	1,574	.29	2.98	3.27
1902.....	406	1,318	1,724	.80	2.58	3.38
1903.....	227	1,699	1,926	.41	3.05	3.46
1904.....	265	1,730	1,995	.46	3.02	3.48
1905.....	312	1,920	2,232	.51	3.12	3.63
1906.....	235	1,903	2,138	.37	3.02	3.39
1907.....	918	2,324	3,242	1.37	3.44	4.81
1908.....	348	2,097	2,445	.51	3.09	3.60
1909.....	498	2,144	2,642	.74	3.22	3.96
1910.....	485	2,336	2,821	.67	3.22	3.89
1911.....	429	2,237	2,666	.58	3.07	3.65
1912.....	251	2,168	2,419	.35	3.00	3.35
1913.....	464	2,321	2,785	.62	3.10	3.72
Total.....	6,637	43,036	49,733	.45	2.87	3.32
1914.....	316	2,138	2,454	.41	2.81	3.22

<sup>a</sup> Exceptional accidents are defined as those in which 5 or more men are killed at one time. Common accidents are those in which less than 5 men are killed at one time.

Table 43 shows, in parallel columns, by years since 1870 the number of men killed in common accidents and those killed in exceptional accidents, with fatality rates for each. For the entire period the rate for the exceptional accidents was 0.45 per 1,000 men employed, and for the common accidents 2.87. The rates for 1914 are slightly below the average. In figure 4 the total fatality rate is represented by a solid line, the common-accident rate by a dotted line, and the exceptional-accident rate by dashes. These curves show the lowest total and common-accident rates between 1885 and 1890. Since then these rates have increased to 1907, from which year there is a decline in the

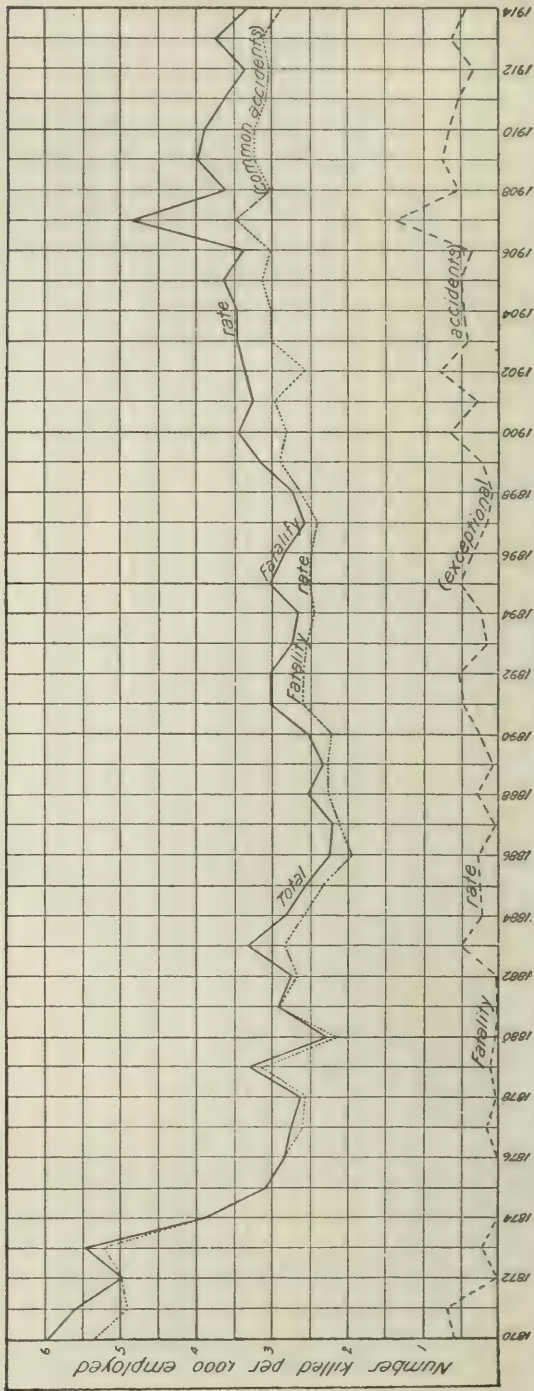


FIGURE 4.—Total number killed per 1,000 employed in coal mines of the United States; also number killed per 1,000 employed, in common and in exceptional accidents, 1870-1914. (Based on Table 43.)

fatality rate. This table shows that 6,692 men were killed in exceptional accidents since 1870, whereas the number killed in common accidents was 43,036. The number of fatalities represented in this table is based on those States for which complete inspection reports have been rendered.

Table 44 gives a *revised* list of all of the mine disasters<sup>a</sup> for which records are available from any source whatever since 1839 to and including 1915. This table presents details of the summary shown in Table 42.

TABLE 44.—COAL-MINE ACCIDENTS IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED. (REVISED TO JAN. 1, 1916.)

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1839. Mar. 18	Black Heath.....	Near Richmond, Va.....	Mine explosion.....	40
1847 Feb. —	Spencer.....	Pottsville, Pa.....	do.....	7
1854 .....	Chesterfield.....	Near Richmond, Va.....	do.....	19
1855 .....	Midlothian.....	Coalfield, Va.....	do.....	55
1869 Sept. 6	Avondale.....	Plymouth, Pa.....	Mine fire.....	179
1870 Mar. 22	Potts.....	Potts Mine, Pa.....	Explosion of breaker boilers.	5
1870 Aug. 10	Heins & Glassmire.....	Middleport, Pa.....	Cage fell down shaft.....	9
1870 Aug. 29	Preston No. 3.....	Girardville, Pa.....	Cage fell down slope.....	7
1871 May 27	West Pittston.....	West Pittston, Pa.....	Smoke from burning breaker.	20
1871 Oct. 2	Otto Red Ash.....	Branch Dale, Pa.....	Mine explosion.....	5
1873 June 10	Henry Clay.....	Shamokin, Pa.....	do.....	10
1876 May 20	Midlothian.....	Coalfield, Va.....	do.....	8
1876 July 24	Black Diamond.....	Nortonville, Cal.....	do.....	6
1877 May 9	Wadesville.....	Wadesville, Pa.....	do.....	7
1877 July 11	Brookfield.....	Brookfield, Ohio.....	Suffocated by gases from mine locomotives.	7
1878 Jan. 15	Potts.....	Locust Dale, Pa.....	Mine explosion.....	5
1878 Nov. 21	Sullivan.....	Sullivan, Ind.....	do.....	8
1879 May 6	Audenried.....	Audenried, Pa.....	do.....	6
1879 Nov. 2	Mill Creek.....	Mill Creek, Pa.....	do.....	5
1880 May 3	Lykens Valley.....	Shamokin, Pa.....	do.....	5
1881 Feb. 10	Robbins.....	Robbins, Ohio.....	do.....	6
1881 Mar. 4	Almy.....	Almy, Wyo.....	do.....	38
1882 Feb. 3	Midlothian.....	Coalfield, Va.....	do.....	32
1882 May 24	Kohinoor.....	Shenandoah, Pa.....	do.....	5
1883 Jan. 9	Coulterville.....	Coulterville, Ill.....	do.....	10
1883 Feb. 16	Diamond.....	Bradwood, Ill.....	Inrush of surface water into workings.	69
1884 Jan. 24	Crested Butte.....	Crested Butte, Colo.....	Mine explosion.....	59
1884 Feb. 20	West Leisenring.....	West Leisenring, Pa.....	do.....	19
1884 Mar. 13	Laurel.....	Pocahontas, Va.....	do.....	112
1884 Aug. 21	Buck Ridge.....	Shamokin, Pa.....	Mine fire.....	7
1884 Oct. 27	Youngstown.....	Uniontown, Pa.....	Mine explosion.....	14
1885 Apr. 6	Cuyler.....	Raven Run, Pa.....	Fall of roof.....	10
1885 Aug. 11	West End.....	Mocanagua, Pa.....	Gas from boiler fires in mine.	10
1885 Oct. 21	Plymouth No. 2.....	Plymouth, Pa.....	Mine explosion.....	6
1885 Dec. 13	Nanticoke No. 1.....	Nanticoke, Pa.....	Buried by inrush of quicksand.	26
1886 Jan. 13	Almy No. 4.....	Almy, Wyo.....	Mine explosion.....	13
1886 Jan. 21	Newburg.....	Newburg, W. Va.....	do.....	39
1886 Aug. 30	Fair Lawn.....	Scranton, Pa.....	do.....	6
1886 Sept. 13	Marvine.....	do.....	Suffocated by inrush of mine gas.	8
1886 Nov. 26	Conyngham.....	Wilkes-Barre, Pa.....	Mine explosion.....	12
1887 Apr. 27	Tunnel.....	Ashland, Pa.....	Suffocated by inrush of mine gas.	5
1887 Oct. 1	Bast.....	Big Mine Run, Pa.....	do.....	5
1888 Mar. 29	Keith & Perry No. 6.....	Rich Hill, Mo.....	Mine explosion.....	24
1888 Nov. 3	Kettle Creek.....	Clinton County, Pa.....	do.....	17
1888 Nov. 9	Shaft No. 2.....	Frontenac, Kans.....	do.....	40
1889 May 9	Kaska William.....	Middleport, Pa.....	Mine car fell on men in cage.	10
1889 Sept. 9	White Ash.....	Jefferson County, Colo.....	Inrush of water from old shaft.	10
1890 Feb. 1	Nottingham.....	Plymouth, Pa.....	Mine explosion.....	8
1890 Mar. 3	Shaft No. 3.....	South Wilkes-Barre, Pa.....	do.....	8
1890 Apr. 2	Susquehanna No. 4.....	Nanticoke, Pa.....	do.....	5
1890 May 15	Jersey No. 8.....	Ashley, Pa.....	do.....	26
1890 June 16	Hill Farm.....	Dunbar, Pa.....	Mine fire.....	31
1891 Jan. 27	Mammoth.....	Mount Pleasant, Pa.....	Mine explosion.....	109

<sup>a</sup> Horton, F. W., Coal mine accidents in the United States: Bull. 69, Bureau of Mines, 1913, p. 45.



## 70 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

TABLE 44.—COAL-MINE ACCIDENTS IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED. (REVISED TO JAN. 1, 1916.)—Continued.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1891 Feb. 4	Spring Mountain No. 1.	Jeanesville, Pa.	Drowned by inrush of water from abandoned workings and asphyxiated by gas from fire built by imprisoned men.	13
1891 Oct. 23	Richardson.	Glencarbon, Pa.	Imprisoned by rush of coal and suffocated by mine gas.	7
1891 Nov. 8	Susquehanna No. 1.	Nanticoke, Pa.	Mine explosion.	12
1892 Jan. 7	No. 11.	Krebs, Okla.	do.	100
1892 Apr. 20	Lytle.	Minersville, Pa.	Drowned by water from old workings.	10
1892 May 10	Roslyn.	Roslyn, Wash.	Mine explosion.	45
1892 July 23	York Farm.	Pottsville, Pa.	do.	15
1893 Jan. 10	Como.	King, Colo.	do.	24
1893 Feb. 14	Chicago and Iowa.	Albia, Iowa.	do.	8
1893 Apr. 1	Neilson.	Shamokin, Pa.	Mine fire.	10
1893 June 22	Susquehanna No. 1.	Nanticoke, Pa.	Mine explosion.	5
1893 Sept. 21	Lance No. 11.	Plymouth, Pa.	do.	6
1894 Feb. 13	Gaylord.	do.	Fall of roof.	13
1894 July 17	East Sugar Loaf.	Stockton, Pa.	Dynamite explosion.	8
1894 Aug. 24	Franklin.	Franklin, Wash.	Mine fire.	37
1894 Oct. 8	Luke Fidler.	Shamokin, Pa.	do.	5
1894 Oct. 11	Henry Clay.	do.	Boiler explosion.	6
1894 Nov. 20	Blanche.	Standard, W. Va.	Mine explosion.	8
1895 Jan. 22	Tate.	Sturgis, Ky.	Powder explosion.	5
1895 Feb. 18	West Bear Ridge.	Mahanoy Plane, Pa.	Mine explosion.	5
1895 Feb. 27	White Ash.	Cerrillos, N. Mex.	do.	24
1895 Mar. 20	Red Canyon.	Red Canyon, Wyo.	do.	60
1895 Apr. 8	Blue Canyon.	Lake Whatcom, Wash.	do.	23
1895 Oct. 7	Dorrance.	Wilkes-Barre, Pa.	do.	7
1895 Dec. 19	Cumnock.	Cumnock, N. C.	do.	39
1895 Dec. 20	Nelson.	Dayton, Tenn.	do.	28
1896 Feb. 18	Vulcan.	New Castle, Colo.	do.	49
1896 Mar. 23	Berwind.	Dubois, Pa.	do.	13
1896 June 28	Twin.	Pittston, Pa.	Fall of roof.	58
1896 Oct. 29	Shaft No. 3.	South Wilkes-Barre, Pa.	Mine explosion.	6
1896 Dec. 26	Oswald.	Princeton, Ind.	do.	7
1897 Jan. 4	No. 1.	Alderson, Okla.	do.	5
1897 Jan. 13	Wadesville.	Wadesville, Pa.	Crosshead fell down shaft.	5
1897 Mar. 4	Kansas & Texas No. 44.	Huntington, Ark.	Mine explosion.	14
1897 Sept. 3	Sunshine.	Sunshine, Colo.	do.	12
1897 Sept. 20	Belle Ellen.	Belle Ellen, Ala.	Mine fire.	5
1897 Sept. 28	Jermyn No. 1.	Rendham, Pa.	do.	5
1897 Oct. 30	Voa Storch.	Seranton, Pa.	do.	6
1898 May 26	Kaska William.	Middleport, Pa.	Drowned by water from old workings.	6
1898 Sept. 23	Umpire.	Brownsville, Pa.	Mine explosion.	8
1898 Oct. 1	Midvale.	Wilkes-Barre, Pa.	Mine fire.	5
1898 Nov. 5	Exeter.	West Pittston, Pa.	Mine car fell on men in cage.	9
1899 Feb. 21	Blocton No. 2.	Blocton, Ala.	Mine explosion.	5
1899 Apr. 21	Cook & White.	Madrid, N. Mex.	do.	5
1899 May 23	Cumnock.	Cumnock, N. C.	do.	23
1899 July 24	Grindstone.	Grindstone, Pa.	do.	5
1899 Dec. 9	Carbon Hill No. 7.	Carbonado, Wash.	do.	31
1899 Dec. 23	Sumner.	Sumner, Pa.	do.	19
1900 Mar. 6	Red Ash.	Red Ash, W. Va.	do.	46
1900 May 1	Winter Quarters 1 and 4.	Scofield, Utah.	do.	200
1900 Aug. 21	Issaquah No. 4.	Issaquah, Wash.	Smoke from burning air shaft.	5
1900 Nov. 2	Berryburg.	Berryburg, W. Va.	Powder explosion.	15
1900 Nov. 9	Buck Mountain.	Mahanoy, Pa.	Mine explosion.	7
1901 Feb. 25	Diamondville No. 1.	Diamondville, Wyo.	Mine fire.	28
1901 Apr. 29	McAlester No. 5.	Alderson, Okla.	Blown-out or windy shot.	6
1901 May 15	Chatham.	Farmington, W. Va.	Mine explosion.	10
1901 May 27	Richland.	Dayton, Tenn.	do.	20
1901 June 10	Port Royal No. 2.	Port Royal, Pa.	do.	19
1901 Sept. 16	Spring Gulch.	Spring Gulch, Colo.	do.	6
1901 Oct. 25	Buttonwood.	Plymouth, Pa.	do.	6
1901 Oct. 26	Diamondville.	Diamondville, Wyo.	do.	22
1901 Nov. 14	Pocahontas.	Pocahontas, Va.	Mine fire and explosion.	9
1901 Nov. 22	do.	do.	Mine fire.	8
1901 Dec. 28	No. 1.	Hartshorne, Okla.	Fell from cage.	6
1902 Jan. 13	Milby & Dow.	Dow, Okla.	Mine fire.	10
1902 Jan. 24	Lost Creek No. 2.	Oskaloosa, Iowa.	Mine explosion.	20
1902 Mar. 6	Catsburg.	Monongahela, Pa.	do.	5
1902 Mar. 31	Nelson.	Dayton, Tenn.	do.	16
1902 May 19	Fraterville.	Coal Creek, Tenn.	do.	184
1902 July 10	Rolling Mill.	Johnstown, Pa.	do.	112
1902 Aug. 7	Bowen.	Bowen, Colo.	do.	13

TABLE 44.—COAL-MINE ACCIDENTS IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED. (REVISED TO JAN. 1, 1916.)—Continued.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1902 Sept. 15	Algoma No. 7	Algoma, W. Va.	Mine explosion	17
1902 Sept. 22	Stafford	Stafford, W. Va.	do	6
1902 Oct. 1	Lawson	Black Diamond, Wash.	do	11
1902 Nov. 29	Luke Fidler	Shamokin, Pa.	do	7
1902 Dec. 9	South Wilkes-Barre	South Wilkes-Barre, Pa.	Dynamite explosion	5
1903 Mar. 15	Cardiff	Cardiff, Ill.	Mine explosion	5
1903 Mar. 23	Athens No. 2	Athens, Ill.	Windy shot	6
1903 Mar. 31	Sandoval	Sandoval, Ill.	Blown-out shot	8
1903 Apr. 12	Central Slope 77	Carbon, Okla.	Mine explosion	6
1903 June 19	Blossburg No. 3	Blossburg, N. Mex.	Powder explosion	5
1903 June 30	Hanna No. 1	Hanna, Wyo.	Mine explosion and fire	169
1903 Nov. 20	Bonanza No. 20	Bonanza, Ark.	Mine explosion	11
1903 Nov. 21	Ferguson	Connellsville, Pa.	do	17
1904 Jan. 25	Harwick	Cheswick, Pa.	do	179
1904 Jan. 30	Maple Hill	Mahanoy City, Pa.	Dynamite explosion	5
1904 Apr. 20	Stearns No. 5	Stearns, Ky.	Mine explosion	5
1904 May 5	Lance	Plymouth, Pa.	Dynamite explosion	5
1904 do	Locust Gap	Locust Gap, Pa.	Mine fire	5
1904 May 11	Big Mudd	Herrin, Ill.	Powder explosion	10
1904 May 25	Williamstown	Williamstown, Pa.	Suffocated by gases from locomotive	10
1904 Oct. 28	Tercio	Tercio, Colo.	Mine explosion	19
1904 Nov. 2	Anchincloss	Nanticoke, Pa.	Fell down shaft	10
1904 Dec. 7	No. 5	Burnett, Wash.	Mine explosion	17
1905 Jan. 16	Decatur	Decatur, Ill.	Mine fire	6
1905 Feb. 18	Lytle	Minersville, Pa.	Fall of roof	5
1905 Feb. 20	Virginia City	Virginia City, Ida.	Mine explosion	108
1905 Feb. 26	Grapevine	Wilcoe, W. Va.	do	6
1905 Mar. 9	Clear Spring	West Pittston, Pa.	Fell down shaft	7
1905 Mar. 18	Rush Run and Red Ash	Red Ash, W. Va.	Mine explosion	24
1905 Mar. 19	Oswald	Princeton, Ind.	do	9
1905 Apr. 3	Leiter	Zeller, Ill.	do	49
1905 Apr. 20	Cabin Creek	Kayford, W. Va.	Powder explosion	6
1905 Apr. 26	Conyngsam	Wilkes-Barre, Pa.	Fell down shaft	10
1905 Apr. 27	Eleanora	Dubois, Pa.	Mine explosion	13
1905 Apr. 30	No. 19	Wilburton, Okla.	do	13
1905 July 6	Fuller	Searight, Pa.	do	6
1905 Oct. 13	Clyde	Fredericktown, Pa.	Mine fire	6
1905 Oct. 29	Hazel Kirk No. 2	Monongahela, Pa.	Mine explosion	5
1905 Nov. 4	Tidewater	Vivian, W. Va.	do	7
1905 Nov. 15	Braznell	Bentleyville, Pa.	do	7
1905 Dec. 1	Diamondville No. 1	Diamondville, Wyo.	do	18
1905 Dec. 4	Horton	Horton, W. Va.	Mine fire	7
1906 Jan. 4	Coaldale	Coaldale, W. Va.	Mine explosion	22
1906 Jan. 18	Detroit	Detroit, W. Va.	do	18
1906 Jan. 24	Poteau No. 6	Witteville, Okla.	Dynamite explosion	14
1906 Feb. 8	Parral	Parral, W. Va.	Mine explosion	23
1906 Feb. 19	Maitland	Walsenburg, Colo.	do	14
1906 Feb. 27	Little Cahaba	Piper, Ala.	do	12
1906 Mar. 22	Century No. 1	Century, W. Va.	do	23
1906 Apr. 22	Cuatro	Tercio, Colo.	do	18
1906 May 15	Shenandoah City	Shenandoah, Pa.	Dynamite explosion	7
1906 June 7	Red Lodge	Red Lodge, Mont.	Mine fire	8
1906 Aug. 6	Susquehanna No. 7	Nanticoke, Pa.	Mine explosion	6
1906 Oct. 3	Pocahontas	Pocahontas, Va.	do	35
1906 Oct. 5	Dutchman	Blossburg, N. Mex.	do	10
1906 Oct. 24	Rolling Mill	Johnstown, Pa.	do	7
1906 Nov. 3	San Toy No. 1	Corning, Ohio	Fell down shaft	5
1906 Dec. 20	Fidelity No. 1	Stone City, Kans.	Powder explosion	7
1906 Dec. 22	Breese-Trenton	Breese, Ill.	Cage with men fell down shaft	6
1907 Jan. 14	Deering No. 7	Clinton, Ind.	Powder explosion	7
1907 Jan. 23	Primero	Primero, Colo.	Mine explosion	24
1907 Jan. 26	Lorentz	Penco, W. Va.	Powder explosion	12
1907 Jan. 29	Johnston City	Johnston City, Ill.	do	7
1907 do	Stuart	Stuart, W. Va.	Mine explosion	84
1907 Feb. 4	Thomas No. 25	Thomas, W. Va.	do	25
1907 Mar. 2	Holden	Taylor, W. Va.	do	7
1907 Mar. 16	Bond and Bruce	Tacoma, Va.	do	11
1907 Apr. 26	Morgan	Black Diamond, Wash.	do	7
1907 May 1	Whipple	Scarboro, W. Va.	do	16
1907 May 19	Engleville	Engleville, Colo.	Mine fire	5
1907 June 13	Johnson No. 1	Priceburg, Pa.	Mine explosion	7
1907 Aug. 17	Sonman	Sonman, Pa.	Fell down shaft	5
1907 Dec. 1	Naomi	Fayette City, Pa.	Mine explosion	34
1907 Dec. 6	Monongah Nos. 6 and 8	Monongah, W. Va.	do	391
1907 Dec. 16	Yolande	Yolande, Ida.	do	56
1907 Dec. 19	Darr	Jacobs Creek, Pa.	do	239
1907 Dec. 31	Bernal	Carthage, N. Mex.	do	11
1908 Jan. 30	Backman	Hawks Nest, W. Va.	do	9

## 72 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

TABLE 44.—COAL-MINE ACCIDENTS IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED. (REVISED TO JAN. 1, 1916).—Continued.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1908 Feb. 10	Moody.....	South Carrollton, Ky....	Mine explosion.....	9
1908 Mar. 28	Hanna No. 1.....	Hanna, Wyo.....	do.....	59
1908 May 12	Mount Lookout.....	Wyoming, Pa.....	do.....	12
1908 May 13	Prospect.....	Middlevale, Pa.....	Fall of roof.....	5
1908 July 15	Williamstown.....	Williamstown, Pa.....	Powder explosion.....	6
1908 Aug. 26	Hailey-Ola No. 1.....	Haileyville, Okla.....	Mine fire.....	29
1908 Aug. 28	Warrior Run.....	Wilkes-Barre, Pa.....	Mine cars.....	6
1908 Nov. 20	Red Lodge.....	Red Lodge, Mont.....	Mine fire.....	9
1908 Nov. 28	Rachel and Agnes.....	Marianna, Pa.....	Mine explosion.....	151
1908 Dec. 29	I lick Branch.....	Switchback, W. Va.....	do.....	50
1909 Jan. 10	Zeisler.....	Zeisler, Ill.....	Mine fire and explosion.....	26
1909 Jan. 12	I lick Branch.....	Switchback, W. Va.....	Mine explosion.....	67
1909 Jan. 19	Stone Canyon.....	Chancellor, Cal.....	do.....	6
1909 Jan. 25	Washington No. 5.....	Franklin, Md.....	Mine cars (surface).....	5
1909 do.	Orenda No. 2.....	Boswell, Pa.....	Mine explosion.....	5
1909 Feb. 2	Short Creek.....	Short Creek, Ala.....	do.....	16
1909 Mar. 2	No. 14.....	Pittston, Pa.....	do.....	8
1909 Mar. 20	Sunnyside.....	Evansville, Ind.....	do.....	6
1909 Mar. 31	Echo.....	Buery, W. Va.....	Dynamite explosion.....	6
1909 Apr. 9	Eureka No. 37.....	Windber, Pa.....	do.....	7
1909 June 23	Lackawanna No. 4.....	Wehrum, Pa.....	Mine explosion.....	21
1909 July 6	Toller.....	Tollerville, Colo.....	do.....	9
1909 Oct. 3	Northwestern.....	Roslyn, Wash.....	do.....	10
1909 Oct. 21	Rock Island No. 8.....	Harishorne, Okla.....	do.....	10
1909 Oct. 31	Franklin No. 2.....	Johnstown, Pa.....	do.....	13
1909 Nov. 9	Auchincloss.....	Nanticoke, Pa.....	Mine fire.....	9
1909 Nov. 13	St. Paul No. 2.....	Cherry, Ill.....	do.....	259
1909 Dec. 11	Baker No. 5.....	Clay, Ky.....	Mine explosion.....	7
1909 Dec. 23	Mine A.....	Herrin, Ill.....	do.....	8
1910 Jan. 11	Nottingham.....	Plymouth, Pa.....	do.....	7
1910 Jan. 31	Primero.....	Primero, Colo.....	do.....	75
1910 Feb. 1	Browder.....	Browder, Ky.....	do.....	34
1910 Feb. 5	Ernest No. 2.....	Ernest, Pa.....	do.....	12
1910 Feb. 8	Barthell No. 1.....	Stearns, Ky.....	do.....	6
1910 Mar. 12	South Wilkes-Barre No. 5.....	Wilkes-Barre, Pa.....	do.....	7
1910 Mar. 31	Great Western No. 2.....	Wilburton, Okla.....	do.....	6
1910 Apr. 20	Mulga.....	Mulga, Ala.....	do.....	40
1910 Apr. 21	Amsterdam.....	Amsterdam, Ohio.....	do.....	15
1910 May 5	Palos No. 3.....	Palos, Ala.....	do.....	83
1910 Oct. 8	Starkville.....	Starkville, Colo.....	do.....	56
1910 Nov. 3	Yolande No. 1.....	Yolande, Ala.....	do.....	5
1910 Nov. 6	Lawson.....	Black Diamond, Wash.....	do.....	16
1910 Nov. 8	Victor American No. 3.....	Delagua, Colo.....	Mine fire and explosion.....	79
1910 Nov. 11	Shoal Creek No. 1.....	Panama, Ill.....	Mine explosion.....	6
1910 Nov. 25	Providence No. 3.....	Providence, Ky.....	Powder explosion.....	10
1910 Dec. 14	Greene.....	Tacoma, Va.....	Mine explosion.....	8
1910 do.	Leyden.....	Leyden, Colo.....	Mine fire.....	10
1910 Dec. 31	I lick Fork.....	Thacker, W. Va.....	Mine cars.....	10
1911 Jan. 20	Carbon Hill.....	Carbon Hill, Va.....	Mine explosion.....	5
1911 Feb. 9	Cokedale.....	Trinidad, Colo.....	do.....	17
1911 Mar. 18	No. 16.....	Mineral, Kans.....	do.....	5
1911 Mar. 22	Hazel.....	Fast Canonsburg, Pa.....	Fall of roof.....	9
1911 Apr. 7	Price-Pancoast.....	Throop, Pa.....	Mine fire.....	72
1911 Apr. 8	Banner.....	Littleton, Ala.....	Mine explosion.....	128
1911 Apr. 24	Ott No. 20.....	Elk Garden, W. Va.....	do.....	23
1911 May 27	Cameron.....	Shamokin, Pa.....	do.....	5
1911 July 13	Sykesville.....	Sykesville, Pa.....	do.....	21
1911 Sept. 12	Marvine.....	Scranton, Pa.....	Mine cars.....	5
1911 Oct. 3	Drifton No. 2.....	Freeland, Pa.....	Cave-in.....	5
1911 Oct. 23	O'Gara No. 9.....	Harrisburg, Ill.....	Mine explosion.....	8
1911 Nov. 9	Adrian.....	Punxsutawney, Pa.....	do.....	8
1911 Nov. 18	Bottom Creek.....	Vivian, W. Va.....	do.....	18
1911 Dec. 9	Cross Mountain.....	Briceville, Tenn.....	do.....	84
1912 Jan. 9	Parrish.....	Plymouth, Pa.....	do.....	6
1912 Jan. 16	Carbon Hill.....	Carbon Hill, Va.....	Dynamite explosion.....	5
1912 Jan. 19	Central.....	Central City, Ky.....	Mine explosion.....	5
1912 Jan. 20	Kemmerer No. 4.....	Kemmerer, Wyo.....	do.....	6
1912 Feb. 22	Western No. 5.....	Lehigh, Okla.....	Mine fire.....	9
1912 Mar. 20	San Bois No. 2.....	McCurtain, Okla.....	Mine explosion.....	73
1912 Mar. 26	Jed.....	Jed, W. Va.....	do.....	81
1912 Apr. 21	Coil.....	Madisonville, Ky.....	do.....	5
1912 June 18	Hastings.....	Hastings, Colo.....	do.....	12
1912 July 11	Panama.....	Moundsville, W. Va.....	do.....	8
1912 July 16	Old Dominion No. 1.....	Carbon Hill, Va.....	do.....	8
1912 July 24	Superba and Lemont.....	Evans Station, Pa.....	Cloudburst flooded mine.....	a 18
1912 Aug. 13	Abernant.....	Abernant, Ala.....	Mine explosion.....	18
1913 Feb. 19	Seagraves.....	Eldorado, Ill.....	do.....	5
1913 Apr. 23	Cincinnati.....	Finleyville, Pa.....	do.....	96
1913 May 6	Taylor.....	Hartford, Ky.....	Overcome by gas.....	5
1913 May 17	Imperial.....	Belle Valley, Ohio.....	Mine explosion.....	15

a Not included in State inspector's statement of mine fatalities.



TABLE 44.—COAL-MINE ACCIDENTS IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED. (REVISED TO JAN. 1, 1916).—Continued.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1913 Aug. 2	East Brookside.....	Tower City, Pa.....	Mine explosion.....	19
1913 Oct. 22	Stag Canon No. 2.....	Dawson, N. Mex.....	do.....	233
1913 Nov. 18	Aeton No. 2.....	Aeton, Ala.....	do.....	24
1913 Dec. 16	Vulcan.....	New Castle, Colo.....	do.....	37
1914 Jan. 10	Rock Castle.....	Rock Castle, Va.....	do.....	12
1914 Jan. 14	Spencer-Newland.....	Mulberry, Kans.....	Cage with men fell down shaft.....	6
1914 Apr. 28	Eccles Nos. 5 and 6.....	Eccles, W. Va.....	Mine explosion.....	181
1914 Apr. 29	Union Pacific No. 2.....	Cumberland, Wyo.....	Mine cars.....	5
1914 May 29	Maryd.....	Maryd, Pa.....	Overwinding of cage.....	6
1914 June 30	Cinderella.....	Cinderella, W. Va.....	Suffocated by fumes from fire in fan house.....	5
1914 Sept. 4	No. 1.....	Adamson, Okla.....	Cave-in.....	13
1914 Sept. 16	Lehigh No. 4.....	Lansford, Pa.....	Mine explosion.....	7
1914 Oct. 5	Mulka.....	Mulka, Va.....	do.....	16
1914 Oct. 27	North or No. 1.....	Royalton, Ill.....	do.....	52
1914 Dec. 9	Tripp.....	Scranton, Pa.....	Collapse of bottom of cage.....	13
1915 Feb. 6	Carlisle.....	Carlisle, W. Va.....	Mine explosion.....	21
1915 Feb. 17	Prospect.....	Wilkes-Barre, Pa.....	do.....	13
1915 Feb. 18	Atlas.....	Rich Hill, Mo.....	Powder and mine explosion.....	5
1915 Mar. 2	Lavland No. 3.....	Lavland, W. Va.....	Mine explosion.....	112
1915 Apr. 5	Shoal Creek.....	Panama, Ill.....	do.....	11
1915 May 24	Smokeless Valley No. 1.....	Johntown, Pa.....	do.....	9
1915 July 27	United Coal No. 1.....	Christopher, Ill.....	do.....	9
1915 July 30	Patterson No. 2.....	Elizabeth, Pa.....	Mine cars.....	9
1915 Aug. 31	Orenda.....	Boswell, Pa.....	Mine explosion.....	19
1915 Nov. 16	Northwestern.....	Ravensdale, Wash.....	do.....	31
1915 Nov. 30	Boomer No. 2.....	Boomer, W. Va.....	do.....	23

#### GAS AND DUST EXPLOSIONS.

Table 45 shows the number of men killed by gas and dust explosions in the coal mines of the United States, by States, during indicated periods ending December 31, 1913, for which continuous records are available. This table takes cognizance of 6,726 fatalities in the coal mines of the United States due to this cause alone, including both common and exceptional accidents. In addition to these accidents a number of mine disasters occurred prior to the beginning of State mine inspection, which are not included in this table. During the periods covered, the fatalities due to gas and dust explosions were 13.88 per cent of the total number killed, or a fatality rate of 0.46 per 1,000 men employed.

Utah has the highest percentage of fatalities in important coal mining States due to this cause, the rate being 57.75 per cent of the total, or 5.34 per 1,000 men employed. Utah's high rate is due to one disaster at the Winter Quarters mine, in which 200 men were killed at one time. New Mexico has the next highest percentage, 56.51 per cent of the total fatalities for a period of 21 years, or 6.46 per 1,000 men employed. This high rate is due to the Dawson disaster, in which 263 men were killed at one time.

The percentage of fatalities due to gas and dust explosions in some of the States is much higher than in others, whereas the rate per 1,000 men employed may not be in accordance therewith. Here again is shown the fallacy of making fatality comparisons on the percentage basis. In Utah and New Mexico the percentage of fatalities due to

falls of roof, 26.76 and 28.17, respectively, indicates exceedingly safe roof conditions in the mines of these States, as this rate is about one-half the average for the United States, which is 47.49 per cent. But the fatality rate due to falls of roof, based on the number of men employed, in New Mexico is 3.22 and in Utah 2.48, both of which are much larger than the average for the United States, which is 1.57 per 1,000 men employed.

TABLE 45.—NUMBER OF MEN KILLED BY GAS AND DUST EXPLOSIONS IN AND ABOUT THE COAL MINES OF THE UNITED STATES, BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.

State.	Number of years in period ended Dec. 31, 1913.	Number killed.		
		Total.	Per cent.	Per 1,000 employed.
Alabama.....	21	620	33.32	1.75
Arkansas.....	9	2	1.87	.05
Colorado.....	28	517	29.75	2.12
Georgia.....	5			
Illinois.....	29	170	4.99	.13
Indiana.....	19	57	8.39	.18
Iowa.....	26	44	6.10	.13
Kansas.....	21	33	6.25	.15
Kentucky.....	26	74	11.65	.23
Maryland.....	23			
Michigan.....	14			
Missouri.....	26	40	10.58	.19
Montana.....	14			
New Mexico.....	21	321	56.51	6.46
North Dakota.....	6			
Ohio.....	30	64	2.79	.07
Oklahoma.....	21	262	35.94	1.96
Oregon.....	5	2	66.67	1.79
Pennsylvania (anthracite).....	44	1,344	7.59	.26
Pennsylvania (bituminous).....	36	1,306	13.82	.40
Tennessee.....	23	339	39.47	1.70
Texas.....	5			
Utah.....	22	205	57.75	5.34
Virginia.....	5	25	9.96	.63
Washington.....	25	195	30.47	1.87
West Virginia.....	29	1,036	21.82	1.09
Wyoming.....	6	67	27.80	1.45
Total <sup>a</sup> .....		6,726	13.88	.46

<sup>a</sup> This table is based on Table 5, and is for periods indicated, by States, for which continuous records are available. It does not necessarily check with Tables 3 and 4, for the reason that the latter tables include intermittent records prior to the period having continuous records.

It will be noted from figure 3 that the accidents due to gas and dust explosions were comparatively few from 1875 to 1890, the rate being about 0.30 per 1,000 men employed. Beginning with 1890 the fatality rate has been very irregular, owing to the irregular occurrence of large diasters. The climax was reached in 1907, when seven explosions occurred, in each of which more than 20 men were killed. The number killed by gas and dust explosions in 1907 was 1.417 per 1,000 employed in all coal mines, or 1.796 (Table 68) per 1,000 for the bituminous mines alone. As shown in Table 4, the fatality rate due to this cause has declined since 1907, being 0.457 per 1,000 in 1914 as compared with the average of 0.487 from 1870 to 1913.

In considering the number of men killed in recent gas and dust explosions, it must not be forgotten that the mines are becoming

deeper, contain more abandoned rooms and old workings, with the possibility of greater accumulations of gas and dust, are larger, and that more men are employed in the individual mines than in former years, so that when an explosion does occur, there is the possibility of trapping more men than would have happened in the same mine 20 or 25 years ago.

With deeper mines and the resultant old workings, ventilation is not as easy to maintain as in the newer mines, thus permitting the accumulation of gas and dust. The deep slope or shaft mines drain all of the water from the upper workings, leaving the haulage ways and rooms dry, with the result that coal dust will be produced and accumulate in them. Water also drains from the gob and waste piles and they become comparatively dry. Air will circulate through abandoned rooms, caved workings and gob, and in so doing the velocity of the air current is reduced and the suspended dust deposited. The air is actually filtered, leaving its deadly burden of dust to be ignited by an explosion of gas or a blown-out shot.

#### MINE FIRES.

Table 46 shows a list of the principal mine fires which have occurred in the United States since 1869, and in which 1,053 men have been killed. This table does not necessarily check with Table 3, for the reason that it includes one disaster in 1869 not shown in Table 3;

TABLE 46.—MINE FIRES IN THE UNITED STATES IN WHICH FIVE OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Killed.
1869 Sept. 6	Avondale.....	Plymouth, Pa.....	179
1884 Aug. 21	Buck Ridge.....	Shamokin, Pa.....	7
1890 June 16	Hill Farm.....	Dunbar, Pa.....	31
1893 Apr. 1	Neilson.....	Shamokin, Pa.....	10
1894 Aug. 24	Franklin.....	Franklin, Wash.....	37
1894 Oct. 8	Luke Fidler.....	Shamokin, Pa.....	5
1897 Sept. 20	Belle Ellen.....	Belle Ellen, Ala.....	5
1897 Sept. 28	Jermyn No. 1.....	Rendham, Pa.....	6
1897 Oct. 30	Von Storch.....	Seranton, Pa.....	5
1898 Oct. 1	Midvale.....	Wilkes-Barre, Pa.....	28
1901 Feb. 25	Diamondville No. 1.....	Diamondville, Wyo.....	9
1901 Nov. 14	Pocahontas.....	Pocahontas, Va.....	8
1901 Nov. 22	do.....	do.....	10
1902 Jan. 13	Milby & Dow.....	Dow, Okla.....	a 169
1903 June 30	Hanna No. 1.....	Hanna, Wyo.....	5
1904 May 6	Locust Gap.....	Locust Gap, Pa.....	6
1905 Jan. 16	Decatur.....	Decatur, Ill.....	6
1905 Oct. 13	Clyde.....	Fredericktown, Pa.....	7
1905 Dec. 4	Horton.....	Horton, W. Va.....	8
1906 June 7	Red Lodge.....	Red Lodge, Mont.....	5
1907 May 19	Engleville.....	Engleville, Colo.....	29
1908 Aug. 26	Hailey-Ola No. 1.....	Haileyville, Okla.....	9
1908 Nov. 29	Red Lodge.....	Red Lodge, Mont.....	a 28
1909 Jan. 10	Zeigler.....	Zeigler, Ill.....	9
1909 Nov. 9	Auchincloss.....	Kingston, Pa.....	259
1909 Nov. 13	St. Paul No. 2.....	Cherry, Ill.....	a 79
1910 Nov. 8	Victor American No. 3.....	Delagua, Colo.....	10
1910 Dec. 14	Leyden.....	Leyden, Pa.....	72
1911 Apr. 7	Price-Pancoast.....	Throop, Pa.....	9
1912 Feb. 22	Western No. 5.....	Lehigh, Okla.....	
Total.....			1,053

a Fire and explosion combined.



it also includes 3 disasters in which a mine fire and explosion were combined. Table 47 shows a list of mine fires at mines in the United Kingdom that were due to spontaneous combustion. This table brings out forcibly the dangers due to spontaneous combustion of waste material stored underground. Too much care can not be exercised in the matter of taking care of waste material, such as waste in engine rooms and pump stations, and old timbers, which may be easily ignited should they come in contact with oil-saturated waste. Timber should not be stored with the mine gob where oxidation is likely to take place, as it will add fuel to a fire which may be easily started. All inflammable material should be removed from the mines.

TABLE 47.—LOSS OF LIFE OCCASIONED BY FIRES DUE TO SPONTANEOUS COMBUSTION IN MINES IN THE UNITED KINGDOM, 1893-1912, INCLUSIVE.<sup>a</sup>

Date of accident.	Name of mine.	County.	Number killed.	Number injured.	Reported cause of death.
1894 Oct. 16	Harecastle and Woodshuts.	North Staffordshire...	1	1	Skull fractured by explosion blowing out stopping.
1895 Oct. 29	Oldfield.....	do.....	2	1	Suffocated by fumes and smoke.
1896 Sept. 10	Shelton.....	do.....	1	.....	Carbon monoxide poisoning.
1898 Apr. 19	Whitwick.....	Leicester.....	35	6	Suffocated by fumes from burning timbers.
1899 Mar. 11	Cadeby Main...	Yorkshire.....	2	2	Explosion ignited by gob fire while working in a "scouring."
1899 Oct. 20	Dalquharran...	Ayrshire.....	1	.....	Suffocated by fumes; gob fire.
1901 Feb. 15	Hill of Beath...	Fife.....	7	.....	Poisoned by carbon monoxide leaking through stoppings.
1901 Nov. 7	Talk o' the Hill	North Staffordshire...	4	.....	Explosion ignited by gob fire.
1902 June 19	Hamstead.....	South Staffordshire...	2	.....	Carbon monoxide poisoning.
1904 Aug. 28	Melgund.....	Fife.....	1	1	Suffocated by products of combustion.
1905 June 24	Coneygre, No. 126 pit.	South Staffordshire...	1	.....	Carbon monoxide and black damp poisoning.
1905 June 25	Haden Hill.....	do.....	2	.....	Do.
1905 Aug. 28	Hamstead.....	do.....	1	.....	Carbon monoxide poisoning.
1906 Apr. 27	Lumphinnans, No. 1 pit.	Fife.....	2	.....	Do.
1906 May 26	Bog, Nos. 1 and 2 pits.	Lanark.....	2	1	Carbon monoxide suffocation.
1906 June 1	Court Herbert.	Glamorgan.....	5	4	Shock of explosion ignited by gob fire.
1907 July 14	Aldridge.....	South Staffordshire...	1	.....	Suffocated by fumes.
1907 Dec. 29	Lochhead.....	Fife.....	3	.....	Carbon monoxide poisoning.
1908 Dec. 23	Cakemare.....	Worcester.....	3	2	Severe burns.
1910 Apr. 17	Windmillend, No. 5 pit.	do.....	2	.....	Carbon monoxide poisoning.
1911 Nov. 25	Signal Hill, Jamage pit.	North Staffordshire...	6	14	Do.
1912 Feb. 2	Bentley.....	Yorkshire.....	3	4	Explosion ignited by gob fire.
1912 Feb. 24	Norton.....	North Staffordshire...	1	1	Do.
1912 July 9	Cadeby Main...	Yorkshire.....	88	.....	Do.
1912 Oct. 27	Cae Duke.....	Glamorgan.....	1	.....	Carbon monoxide poisoning.
Total...	.....	.....	177	37	.....

<sup>a</sup> First report of the departmental committee on spontaneous combustion of coal in mines, Home Office, London, 1914.

### EXPLOSIVES.

Table 48 shows by causes and States the total number of fatalities due to explosives, during periods of inspection service for which continuous records are available. The fatality rates due to explosives from 1870 to 1914 are shown in figure 3. In Table 48 are tabulated 3,675 fatalities due to the use of explosives underground. This table has been divided into 14 subheadings showing various causes of accidents while using explosives, and it will be noted that 24.87 per cent are due to premature blasts, 16.79 per cent to handling and transportation, 16.71 per cent to flying pieces of rock or coal. The number of fatalities due to striking unexploded charges in removing debris is small, only three being reported. The small number of fatalities due to thawing of explosives is largely accounted for by the fact that black powder is used to such a large extent in the coal mines. Dynamite is not used so extensively and hence there are not so many accidents due to thawing as in the metal mines, where dynamite is used almost exclusively. Of the 27 fatalities due to thawing explosives, 21 occurred in the anthracite mines of Pennsylvania, where a large amount of dynamite is used. The table presents a detailed study which has not heretofore been available, and it is hoped that it will be of some special use to safety engineers in forming rules and regulations concerning the use of explosives.

The table also gives the percentage of fatalities and the rate per 1,000 men employed. In Kansas and North Dakota nearly one-fourth of all coal-mine fatalities is due to the use of explosives. Although in Indiana 19.44 per cent and in Oklahoma 15.77 per cent are due to this cause, the average for the United States is 7.59 per cent.

Table 49 gives the number of fatalities due to explosives in and about the anthracite mines of Pennsylvania from 1870 to and including 1913. This table shows that 1,835 fatalities were due to this cause alone, of which 1,790 were underground, as indicated in Table 48. Table 49 also shows the fatality rate per 1,000 men employed as being 0.225 in 1870. This rate fluctuates more or less, but it has more than doubled in recent years, ranging from 0.414 in 1909 to 0.540 in 1908 and 0.427 in 1913. The average fatality rate per 1,000 men employed in the anthracite field during the entire period of 44 years is 0.354, as compared with 0.05 in the bituminous fields of Pennsylvania, in which there were 185 fatalities as compared with 1,790 in the anthracite field.

Anthracite coal being much harder than bituminous coal, more nearly approaches metal-mining operations, and of course larger quantities of more powerful explosives are required. Table 50 shows that the amount of explosives used in the anthracite field is practically three times the amount used in the bituminous mines of

TABLE 45.—NUMBER OF MEN KILLED BY EXPLOSIVES IN THE COAL MINES (UNDERGROUND ONLY) OF THE UNITED STATES, BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.<sup>a</sup>

State.	Num- ber of years in period ended Dec. 31, 1913.	Handling and trans- por- ta- tion.	Handling caps, de- tonators, squibs, and fuse.	Thaw- ing ex- plo- sives.	Tamp- ing.	Premat- ure blast and short fuse.	Blown out or windy shot.	Flying pieces of rock or coal.	Re- turned too soon.	De- layed blast.	Shot break- ing through pillar or rib.	Suffo- cation by powder gas.	Striking unex- posed charge in removing debris.	Drilling into unex- posed charge.	Un- classi- fied.	Total.	Per- centage of total killed in State.	Num- ber killed per 1,000 em- ployed.	
Alabama.....	21	7			2	10	12	8	16	1	2	1			37	96	5.16	0.24	
Arkansas.....	9														15	15	14.01	.34	
Colorado.....	28	2	2			19	3	5	2	2	1	6		9	9	60	3.45	.25	
Georgia.....	5														1	1	14.29	.43	
Illinois.....	29	86	1		10	94	81	47	52	3	32	7		11	32	459	13.47	.34	
Indiana.....	19	23			3	28	16	6	12	3	12	19			8	12	19.44	.42	
Iowa.....	25	9	1			18	4	25	3	4	4	1		2	7	74	10.25	.23	
Kansas.....	21	11	9		1	13	19	22	3		3	29			21	131	24.81	.61	
Kentucky.....	26	13	4			11	17	3	13	1	7	6		4	10	89	14.02	.28	
Maryland.....	23	2	1			6			1						1	5	2.27	.04	
Michigan.....	14		1			6									3	15	15.31	.33	
Missouri.....	26	3				4			8	2	5	8		1	4	43	11.38	.20	
Montana.....	14	2		1		1			1	1		2			3	11	6.92	.27	
New Mexico.....	21					4	5	5	1	3	1	1		2	2	24	4.23	.48	
North Dakota.....	6					1									2	3	23.08	.72	
Ohio.....	30	19	2			42	1	12	8	2	24	7			44	161	7.02	.17	
Oklahoma.....	21	16	1			9	19	14	10	3	6	6			31	115	15.77	.86	
Oregon.....	5															0			
Pennsylvania (an- thrifice).....	44	318	10	21	88	583		420	126	9	77	10	3	26	99	1,790	10.10	.35	
Pennsylvania (bi- tuminous).....	35	45	6	1	2	34	13	31	19	1	24	3		3	3	185	1.95	.05	
Tennessee.....	23	3				2	5	2	4		3	5			25	49	5.70	.25	
Texas.....	5														2	2	8.00	.09	
Utah.....	22	1				3		1								5	1.40	.13	
Virginia.....	5														10	10	3.98	.25	
Washington.....	25	2	2	2		1			1	2	1	15		3	3	32	5.00	.30	
West Virginia.....	29	54	4	2	3	30	6	2	7		10	1		1	35	155	3.27	.16	
Wyoming.....	6	1				2			6		1			2	1	13	5.40	.28	
Total <sup>b</sup> .....		617	44	27	109	914	201	614	293	33	216	127	3	69	408	3,675	7.59	.25	
Percentage of total.....		16.79	1.20	0.73	2.97	24.87	5.47	16.71	7.97	0.90	5.88	3.45	0.08	1.88	11.10	100.00			

<sup>a</sup> Compiled from the annual reports of the State mine inspectors.<sup>b</sup> This table is based on Table 6, and is for periods indicated by States for which continuous records are available. It does not necessarily check with Tables 3 and 4 for the reason that the latter tables include intermittent records prior to the period having continuous records.



Pennsylvania. In 1913 the bituminous fields used 14,652,931 pounds of black powder as compared with 44,001,660 pounds in the anthracite mines. The bituminous mines for the same year used 696,162 pounds of dynamite, whereas the anthracite mines used in the same period 16,093,035 pounds. The amount of permissible explosives used in the bituminous fields was 6,715,028 pounds as compared with 3,323,645 in the anthracite fields. Records showing the use of permissible explosives are not complete prior to 1909.

TABLE 49.—FATALITIES IN AND ABOUT THE ANTHRACITE MINES OF PENNSYLVANIA DUE TO EXPLOSIVES.

Year.	Number killed by—													Total.	Number killed per 1,000 employed. <sup>a</sup>
	Handling and transportation.	Handling caps, detonators, squibs, and fuse.	Thawing explosives.	Tamping.	Remature blast or short fuse.	Blown-out or windy shot.	Flying pieces of coal or rock.	Returned too soon.	Delayed blast.	Shot breaking through pillar or rib.	Suffocation by powder gas.	Striking unexploded charge in removing debris.	Drilling into unexploded charge.	Miscellaneous causes.	
1870.....	1				2		4							1	8
1871.....	4				4		5	1		1				1	16
1872.....	4				6		5								16
1873.....	1				9		4	2							16
1874.....	2			2	4		3	1		1			1		14
1875.....	9			1	7		10	2		1					30
1876.....	15			1	2		10	1		1	1		2		33
1877.....	3			1	1		5			1	1				12
1878.....	6				5		4	1					1		17
1879.....	7				3		2	2		1			1		17
1880.....	1			1	6		1	1			1				11
1881.....	2				5		7	3		1				1	19
1882.....	5			1	3		7	2		2				1	21
1883.....	9			2	20		4	3		2	1				41
1884.....	3				12		13	4		2			1		35
1885.....	9			3	8		2	3		3			2		30
1886.....	3			1	5		12	5							26
1887.....	4				6		9							1	20
1888.....	6			3	17		6	2		1			1	2	38
1889.....	3			2	11		8	3		3				4	33
1890.....	6			1	7		4	3		2					18
1891.....	6		3	3	22		3	4		2			1		44
1892.....	5				14		8	2		5					36
1893.....	5		1	1	14		11	4		2			1	2	41
1894.....	14		1	6	12		10	2		1					46
1895.....	14		2	1	16		5	1		6			3	4	52
1896.....	5			1	13		13	3		3					38
1897.....	4	1		2	18		9	9		4	1				51
1898.....	4	1		1	12		11	2		2			1		34
1899.....	4			2	14		10	4		1					35
1900.....	8		2		20		10	1		2					43
1901.....	10		3	2	19		9	6		2		1		2	54
1902.....	7		1	3	11		4	4		1					31
1903.....	13	1	1		22		16	3						4	60
1904.....	19	1	2	3	14		13	6					1	11	70
1905.....	9		2	2	27		9	2		6			2	6	63
1906.....	19		1	2	34		15		1	1	1		1	11	86
1907.....	5		1	16	31		13	7				2	2	12	89
1908.....	10	2	1	7	28		21	5		3	2		1	14	94
1909.....	9	2	1	3	14		15	6	1	3	1			11	69
1910.....	17	1		2	24		26	3	4	1				7	85
1911.....	15		2	6	27		18	9	1	4			2	4	88
1912.....	18	1		6	21		23	2		3			1	5	80
1913.....	5		1		21		35	1	2	1	2			7	75
Total Surface.....	325	10	25	89	591		432	126	9	77	10	3	26	112	1,835
Underground.....	318	10	21	88	583		420	126	9	77	10	3	26	99	1,790

<sup>a</sup> Based on total employees as given in Table 124.<sup>b</sup> Included in the 2,321 surface fatalities, Table 5.

TABLE 50.—EXPLOSIVES USED IN THE COAL MINES OF PENNSYLVANIA.<sup>a</sup>

Year.	Quantity of explosives used in anthracite mines.			Quantity of explosives used in bituminous mines.		
	Black powder.	Dynamite.	Permissible explosives.	Black powder.	Dynamite.	Permissible explosives.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1899.....	34,317,275	3,649,417	.....	6,600,700	222,076	.....
1900.....	30,929,500	3,454,641	.....	7,469,925	243,517	.....
1901.....	38,020,100	4,155,685	.....	7,851,500	693,801	.....
1902.....	21,128,675	2,130,965	.....	9,966,725	921,149	.....
1903.....	42,529,400	5,317,422	.....	11,145,725	1,133,305	.....
1904.....	44,779,800	6,519,312	.....	12,026,275	1,330,161	.....
1905.....	47,570,500	8,353,504	.....	15,194,100	2,159,080	.....
1906.....	40,352,075	7,980,733	.....	18,119,000	2,425,073	.....
1907.....	47,636,700	10,544,781	.....	13,874,225	3,425,404	.....
1908.....	49,380,800	10,766,245	.....	12,738,800	2,193,944	.....
1909.....	41,191,857	10,724,616	666,827	12,221,214	694,129	3,291,400
1910.....	45,112,322	11,171,458	1,506,140	12,539,013	513,665	5,126,251
1911.....	47,846,483	13,369,056	2,122,244	12,925,731	658,330	4,462,416
1912.....	41,401,015	13,685,002	2,037,023	13,402,034	527,897	5,699,176
1913.....	44,001,660	16,093,035	3,323,045	14,052,931	696,102	6,715,028

<sup>a</sup> Ann. Rept. Department of Mines of Pennsylvania, 1913, pp. 59, 75.

## PERMISSIBLE EXPLOSIVES.

The number of fatalities per 10,000 men employed, due to explosives used in the bituminous coal mines of the United States from

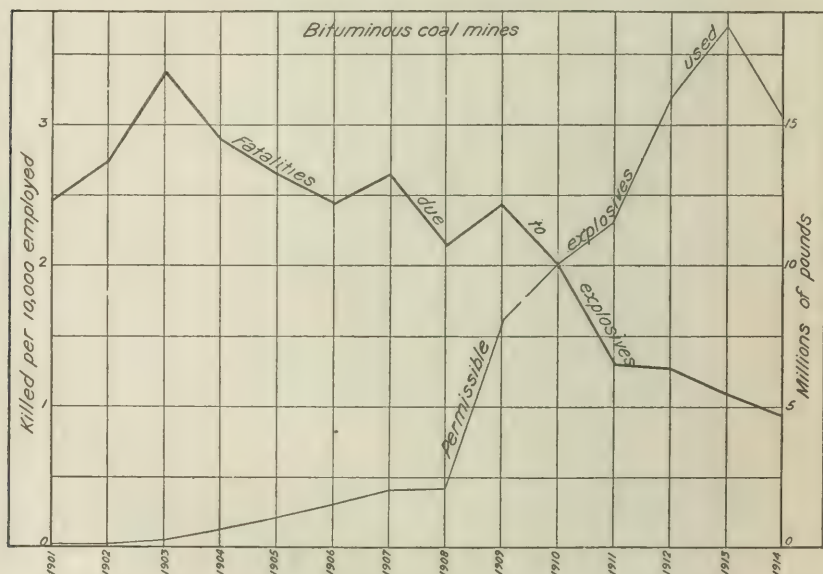


FIGURE 5.—Number of men killed per 10,000 employed, by explosives, in the bituminous coal mines of the United States, compared with the amount of permissible explosives used, 1901-1914. (Based on Table 68.)

1901 to 1914, inclusive, are shown in figure 5. The figure also shows the amount of permissible explosives used for the same period. This period is taken for the reason that in 1901 there were no permissible explosives used in the coal mines of the United States. In 1902 this

class of explosives was introduced, there being 11,300 pounds used during that year. In preparing this chart, the amount of permissible explosives used in the anthracite mines has been eliminated, leaving the figures for bituminous mines only. This chart shows the rapid increase in the use of permissible explosives and, at the same time, a corresponding decrease in the fatality rate. None of the serious mine disasters have been attributed to permissible explosives.

Table 51 shows the amount of black powder, high explosive other than permissible, and permissible explosive used in the coal mines of the United States, geographically grouped, wherein the mining conditions are more or less of a similar character. This table is for the two years 1913 and 1914.

TABLE 51.—QUANTITY OF **EXPLOSIVES** USED IN THE COAL MINES OF THE UNITED STATES DURING 1913 AND 1914.<sup>a</sup>

States.	Quantity of explosives used.					
	Black blasting powder. <sup>b</sup>		High explosives, other than permissible explosives.		Permissible explosives.	
	1913	1914	1913	1914	1913	1914
	<i>Kgs.</i>	<i>Kgs.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Maryland and Virginia.....	124,239	103,250	471,475	286,500	134,000	441,825
Pennsylvania.....	2,535,098	2,477,542	18,198,494	19,204,406	9,622,475	8,989,625
West Virginia.....	614,392	566,692	645,425	510,725	3,282,560	2,904,449
Georgia and North Carolina.....	7,930	5,400	5,680	2,800	.....	.....
Indiana and Kentucky.....	762,815	704,338	699,201	208,734	482,250	564,525
Illinois.....	1,269,974	1,195,026	172,300	143,450	1,569,175	1,327,575
Ohio.....	305,581	192,097	62,300	547,700	6,650	11,200
Alabama and Tennessee.....	315,942	247,327	722,610	913,775	4,481,975	2,982,363
Michigan.....	21,421	28,999	20,125	31,900	.....	.....
Iowa, Kansas, and Missouri.....	875,691	941,702	1,430,550	1,076,450	21,125	15,237
Arkansas, Oklahoma, and Texas.....	309,390	294,177	455,050	665,770	356,500	396,700
Montana, North Dakota, South Dakota, and Wyoming.....	161,082	158,270	145,975	154,150	252,625	261,850
Colorado, New Mexico, and Utah.....	82,416	84,541	615,670	243,760	1,381,950	1,534,900
Alaska, Idaho, Oregon, and Washington.....	9,940	13,115	473,568	225,825	167,600	163,643
California and Nevada.....	802	.....	24,650	.....	45,400	.....
Total.....	7,396,683	7,072,506	24,143,133	24,215,945	21,804,285	19,593,892

<sup>a</sup> Fay, A. H., Production of explosives in the United States during 1914, Tech. Paper 107, 1915, pp. 10-12.

<sup>b</sup> Kgs of 25 pounds each.

QUANTITY OF EXPLOSIVES USED IN THE COAL MINES OF WEST VIRGINIA.<sup>a</sup>

Year.	Number of operators reporting.	Black powder.	Dynamite.	So-called safety powder.
		<i>Kgs.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1905.....	395	373,669	.....	.....
1906.....	409	447,306	.....	.....
1907.....	460	443,989	.....	.....
1908.....	498	425,342	788,049	453,074
1909.....	458	391,282	281,529	1,170,861
1910.....	580	459,273	303,646	1,661,861
1911.....	693	409,312	141,209	3,022,682
1912.....	678	409,540	114,680	3,430,759
1913.....	698	( <sup>b</sup> )	( <sup>b</sup> )	2,010,823

<sup>a</sup> Compiled from State mine inspectors' reports. <sup>b</sup> Not given.



YEARLY SALES OF SHORT-FLAME EXPLOSIVES USED IN COAL MINES IN THE UNITED STATES, 1901-1914.<sup>a</sup>

Year.	Quantity sold.	Year.	Quantity sold.
	<i>Pounds.</i>		<i>Pounds.</i>
1901.....		1908.....	2,108,610
1902.....	11,300	1909.....	8,942,857
1903.....	288,661	1910.....	11,820,836
1904.....	608,270	1911.....	13,428,239
1905.....	1,031,300	1912.....	18,150,618
1906.....	1,533,575	1913.....	21,804,285
1907.....	2,095,244	1914.....	19,593,892

<sup>a</sup> Fay, A. H., Production of explosives in the United States during 1914: Tech. Paper 107, Bureau of Mines, 1915, p. 13.

QUANTITY OF PERMISSIBLE EXPLOSIVES USED IN DIFFERENT COAL FIELDS IN THE UNITED STATES, 1910-1914.<sup>a</sup>

Coal fields and regions.	1910	1911	1912	1913	1914
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1. Pennsylvania anthracite field.....	1,486,100	1,917,412	2,177,172	3,294,225	4,380,635
2. Northern Appalachian region <sup>b</sup> .....	5,967,216	6,350,272	9,190,025	9,744,810	7,966,464
3. Southern Appalachian region.....	3,188,785	3,377,268	3,995,485	4,481,975	3,510,013
4. Eastern interior field.....	165,975	337,012	751,005	2,058,075	1,364,450
5. Western interior field.....	190,560	255,050	440,825	377,625	411,937
6. Rocky Mountain region.....	808,200	1,177,075	1,473,129	1,634,575	1,796,750
7. Pacific coast region.....	8,000	14,150	122,977	213,000	163,643
Total.....	11,820,836	13,428,239	18,150,618	21,804,285	12,593,892

<sup>a</sup> Fay, A. H., Production of explosives in the United States during 1914: Tech. Paper 107, Bureau of Mines, 1915, p. 13.

<sup>b</sup> Not including Pennsylvania anthracite field.

## FALLS OF ROOF.

Table 52 shows the number of fatalities due to falls of roof and pillar coal in and about the coal mines of the United States, by States, during periods ending December 31, 1913, for which continuous records are available. During these various State periods there were 23,011 fatalities due to falls of rock and coal alone. This represents 47.49 per cent of the total number of fatalities, or a fatality rate of 1.57 per 1,000 men employed. (See fig. 3. Pls. I and II.)

It is not always in the mines having the strongest roof where the least number of fatalities occur. When a mine is known to have a bad roof, the miner, foreman, and all others concerned will take special precautions to use plenty of timber to keep the roof in place. Furthermore, the roof will be tested frequently and the miner will be on the lookout at all times when he knows that roof conditions are bad. With a strong roof, however, such precautions are not taken. The miner and the foreman consider the roof safe and give it no further thought. This leads to negligence, and as a result many of the fatalities due to roof falls happen where roof conditions are considered the best.

TABLE 52.—NUMBER OF MEN KILLED BY FALLS OF ROOF AND PILLAR COAL IN THE COAL MINES OF THE UNITED STATES, BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE. <sup>a</sup>

State.	Number of years in period ended Dec. 31, 1913.	Number killed.		
		Total.	Per cent.	Per 1,000 employed.
Alabama.....	21	713	38.31	2.01
Arkansas.....	9	65	60.75	1.46
Colorado.....	28	852	49.02	3.50
Georgia.....	5	6	85.71	2.60
Illinois.....	29	1,616	47.40	1.19
Indiana.....	19	306	45.07	.97
Iowa.....	26	426	59.00	1.31
Kansas.....	21	259	49.05	1.20
Kentucky.....	26	316	49.76	.98
Maryland.....	23	127	57.73	1.08
Michigan.....	14	51	52.04	1.13
Missouri.....	26	235	62.17	1.10
Montana.....	14	88	55.34	2.15
New Mexico.....	21	160	28.17	3.22
North Dakota.....	6	6	46.16	1.44
Ohio.....	30	1,509	65.84	1.57
Oklahoma.....	21	153	20.99	1.14
Oregon.....	5	1	33.33	.90
Pennsylvania (anthracite).....	44	7,378	41.65	1.42
Pennsylvania (bituminous).....	36	5,393	56.93	1.64
Tennessee.....	23	361	42.03	1.81
Texas.....	5	16	64.00	.67
Utah.....	22	95	26.76	2.48
Virginia.....	5	131	52.19	3.33
Washington.....	25	182	28.44	1.75
West Virginia.....	29	2,452	51.64	2.57
Wyoming.....	6	114	47.30	2.46
Total.....		23,011	47.49	1.57

<sup>a</sup> This table is based on Table 5, and is for periods indicated by States for which continuous records are available. It does not necessarily check with Tables 3 and 4 for the reason that the latter tables include intermittent records prior to the period having continuous records.

Falls of roof form the principal cause of accidents in coal mines, a fact that should command the serious attention of the inspectors, operators, mine foremen, and the miners. Roof falls are bound to happen, yet with proper precautions, use of sufficient timber, and care on the part of the foremen and miners the number of accidents from this cause should be reduced to a considerable extent.

#### HAULAGE SYSTEMS.

Table 53 shows the number of men killed underground by mine cars and locomotives covering periods for which continuous records are available, including 1913. This class represents one-eighth of the total number of men killed in and about the coal mines, or 0.42 per 1,000 men employed. During the periods covered 6,056 men were killed by mine cars and locomotives. (See fig. 3. Pls. I and II.) This number, however, does not include accidents due to electricity on haulage systems nor injuries inflicted by animals. Details relating to haulage systems of all of the various States are not available, but as an example to show the character of haulage used it has been possible to prepare tables for Illinois, Ohio, West Virginia, and the anthracite and bituminous mines of Pennsylvania.

Table 54 shows the number of horses and mules and steam, electric, and compressed-air locomotives used in the Pennsylvania coal mines from 1898 to 1913. The number of animals used in anthracite haulage has not changed materially during this 15-year period. The number of steam locomotives has practically doubled, the number of electric locomotives has increased from 24 to 781, and the number of compressed-air locomotives has increased from 10 to 161. The number of horses and mules used in bituminous haulage in Pennsylvania has doubled during this period. The number of steam locomotives has increased but slightly, whereas the number of electric locomotives has increased from 122 in 1899 to 1,933 in 1913. The use of compressed-air locomotives has increased in about the same ratio as in the anthracite field, there being 13 in 1899 and 168 in 1913.

TABLE 53.—NUMBER OF MEN KILLED UNDERGROUND BY MINE CARS AND LOCOMOTIVES IN THE COAL MINES OF THE UNITED STATES, BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.<sup>a</sup>

State.	Number of years in period ended Dec. 31, 1913.	Number killed.		
		Total.	Per cent.	Per 1,000 employed.
Alabama.....	21	193	10.37	0.55
Arkansas.....	9	2	1.87	.05
Colorado.....	28	141	8.11	.58
Georgia.....	5			
Illinois.....	29	414	12.14	.30
Indiana.....	19	75	11.04	.24
Iowa.....	26	76	10.53	.23
Kansas.....	21	12	2.27	.06
Kentucky.....	26	46	7.25	.14
Maryland.....	23	30	13.64	.25
Michigan.....	14	2	2.04	.04
Missouri.....	26	19	5.03	.09
Montana.....	14	23	14.47	.56
New Mexico.....	21	43	7.57	.87
North Dakota.....	6	2	15.38	.48
Ohio.....	30	277	12.08	.29
Oklahoma.....	21	78	10.70	.58
Oregon.....	5			
Pennsylvania (anthracite).....	44	2,403	13.56	.46
Pennsylvania (bituminous).....	36	1,452	15.33	.44
Tennessee.....	23	49	5.70	.25
Texas.....	5	2	8.00	.08
Utah.....	22	25	7.04	.65
Virginia.....	5	32	12.75	.81
Washington.....	25	81	12.65	.78
West Virginia.....	29	557	11.73	.58
Wyoming.....	6	22	9.13	.48
Total.....		6,056	12.50	.42

<sup>a</sup> This table is based on Table 5 and is for periods indicated, by States, for which continuous records are available. It does not necessarily check with Tables 3 and 4 for the reason that the latter tables include intermittent records prior to the period having continuous records.

In 1900 of the total amount of coal mined in Illinois, 5.5 per cent was transported by electric haulage underground, 10.1 per cent by cable haulage, and 84.4 per cent by horse and mule haulage. In 1912 the electric haulage systems handled 67.7 per cent, the cable haulage 0.7 per cent, and horse and mule haulage 31.6 per cent. In figuring these percentages the amount of coal handled by hand and



TABLE 54.—TYPES OF HAULAGE SYSTEMS, AND NUMBER OF UNITS EMPLOYED IN EACH, IN AND ABOUT THE COAL MINES OF PENNSYLVANIA.<sup>a</sup>

Year.	Anthracite mines.						Bituminous mines.					
	Horses and mules.	Steam locomotives.	Electric locomotives.	Compressed-air locomotives.	Electric dynamos.	Air compressors. <sup>c</sup>	Horses and mules.	Steam locomotives.	Electric locomotives.	Compressed-air locomotives.	Electric dynamos.	Air compressors. <sup>c</sup>
1898.....	15,910	(b)	24	10	44	99	6,310	(b)	(b)	(b)	(b)	(b)
1899.....	15,690	352	29	24	45	116	8,013	110	122	13	156	160
1900.....	15,708	365	38	30	60	139	9,633	119	174	17	196	225
1901.....	16,059	362	40	51	66	140	10,108	134	231	23	241	255
1902.....	16,139	373	53	55	70	146	11,823	130	323	16	306	336
1903.....	16,872	405	84	71	81	166	12,890	162	435	23	391	446
1904.....	17,085	412	115	88	100	200	12,849	169	560	27	463	503
1905.....	17,500	454	184	98	117	217	13,710	161	600	31	479	553
1906.....	17,972	445	223	108	135	237	14,707	162	833	43	535	562
1907.....	17,125	492	338	111	148	286	15,323	174	1,014	50	623	638
1908.....	16,837	489	425	144	183	292	14,486	170	965	67	651	631
1909.....	16,122	529	459	128	196	285	14,722	163	1,169	109	717	635
1910.....	15,847	552	538	142	233	295	13,741	166	1,358	149	756	671
1911.....	15,625	573	635	148	249	298	13,774	145	1,438	165	754	653
1912.....	15,187	575	707	163	255	371	13,908	168	1,617	164	845	641
1913.....	15,109	607	781	161	261	332	13,868	148	1,933	168	889	620

<sup>a</sup> Compiled from annual reports of the Department of Mines, Harrisburg, Pa.<sup>b</sup> No report.<sup>c</sup> For haulage and other purposes.

TABLE 55.—PERCENTAGE OF COAL HANDLED UNDERGROUND IN ILLINOIS MINES BY ELECTRIC, ROPE, AND ANIMAL HAULAGE WITH FATALITIES DUE TO HAULAGE SYSTEMS.

Year.	Percentage of coal hauled by a—			Number of men killed in haulage accidents.	
	Electric haulage.	Rope system.	Animals.	Total.	Per 1,000 employed.
1900.....	5.5	10.1	84.4	13	0.332
1901.....	8.1	10.5	81.4	12	.287
1902.....	8.5	9.7	81.8	16	.337
1903.....	10.8	8.1	81.1	20	.395
1904.....	11.3	4.1	84.6	18	.329
1905.....	12.4	3.8	83.8	21	.362
1906.....	19.1	4.4	76.5	23	.378
1907.....	35.9	6.1	58.0	41	.625
1908.....	40.0	6.7	53.3	27	.397
1909.....	45.8	2.9	51.3	24	.346
1910.....	49.5	5.3	45.2	33	.454
1911.....	60.5	4.7	34.8	43	.568
1912.....	67.7	.7	31.6	44	.563

<sup>a</sup> Calculated from data published in the State mine inspectors' annual reports.

TABLE 56.—SUMMARY OF THE NUMBER OF MINE LOCOMOTIVES IN WEST VIRGINIA DURING THE FISCAL YEARS ENDING JUNE 30, 1899-1913, INCLUSIVE.<sup>a</sup>

Year.	Number of mines using locomotives.	Number of locomotives in use.				Total.
		Electric.	Steam.	Compressed air.	Gasoline.	
1899.....	63	24	64	3	.....	91
1900.....	72	43	69	4	.....	116
1901.....	96	78	60	3	.....	141
1902.....	109	107	64	2	.....	173
1903.....	145	154	74	3	.....	231
1904.....	168	206	77	6	.....	289
1905.....	243	253	90	3	.....	346
1906.....	281	335	83	3	.....	421
1907.....	333	439	76	4	.....	519
1908.....	404	590	81	5	.....	676
1909.....	402	723	78	10	.....	811
1910.....	483	888	72	7	.....	967
1911.....	447	921	54	33	.....	1,008
1912.....	480	1,194	62	38	17	1,311
1913.....	502	1,365	46	40	28	1,479

<sup>a</sup> Compiled from State mine inspector's annual reports.

other haulage was small and was therefore disregarded. Table 55 shows the percentage of coal handled by the three systems. The fatalities, shown in a parallel column, include in addition to those due to mine cars and locomotives underground, 13 fatalities due to animals and 8 fatalities from electric shock as being attributable to the haulage system. The table shows in general an increasing rate, which is due not so much to electricity as to the more rapid transit and the nearer approach to railroad operations.

Table 56 shows the number of mine locomotives in use in West Virginia from 1899 to 1913. The number of mines using locomotives in 1899 was 63, while in 1913 it was 502. The number of electric locomotives has increased from 24 in 1899 to 1,365 in 1913. The number of steam locomotives has decreased slightly, having dropped

from 64 in 1899 to 46 in 1913. The use of compressed-air locomotives has not increased and in 1912 gasoline locomotives were introduced, 17 being installed in that year and 28 in 1913.

TABLE 57.—MINING MACHINES AND ELECTRIC-HAULAGE MOTORS IN OHIO MINES.<sup>a</sup>

Year.	Mining machines.			Electric-haulage motors.
	Electric.	Compressed air.	Total.	
1889.....	4	(b)	(b)	1
1890.....	15	(b)	(b)	2
1891.....	25	89	114	2
1892.....	27	102	129	2
1893.....	41	107	148	2
1894.....	59	112	171	2
1895.....	82	82	164	2
1896.....	130	79	209	6
1897.....	166	67	233	10
1898.....	194	58	252	22
1899.....	236	44	280	28
1900.....	322	40	362	50
1901.....	389	40	429	62
1902.....	527	47	574	96
1903.....	696	78	774	143
1904.....	888	87	975	186
1905.....	1,001	145	1,146	214
1906.....	1,110	156	1,266	275
1907.....	1,272	124	1,396	359
1908.....	1,316	129	1,445	383
1909.....	1,267	128	1,395	405
1910.....	1,374	99	1,473	451
1911.....	1,457	85	1,542	485
1912.....	1,491	58	1,549	525
1913.....	1,604	49	1,653	612

<sup>a</sup> Compiled from the annual reports of the State mine inspector.

<sup>b</sup> Not reported.

In Table 57 is shown the number of electric haulage motors used in Ohio from 1889 to 1913. In 1889 there was only one electric haulage motor; in 1913 there were 612. The table also shows the increase in the number of electric and compressed-air mining machines.

#### ACCIDENTS DUE TO ELECTRICITY.

Table 58 shows the number of fatalities by States in and about the coal mines due to electricity since its introduction into the mines. These include both surface and underground fatalities, of which there were 710. The largest percentage of this number of fatalities was due to direct contact with the trolley wire. This group represents practically 50 per cent of the total number of fatalities. The next largest group is that due to contact with machine feed wire, by which 131 were killed, representing 18.45 per cent. The miscellaneous column is unfortunately large, inasmuch as sufficient details were not given in the description of the individual accidents in order to enable a proper classification of these fatalities. Many of them were reported simply as "electrocuted," no details whatever being given; hence this column represents 128 fatalities, or 18 per cent of the total.



TABLE 58.—TOTAL FATALITIES DUE TO **ELECTRICITY** IN THE COAL MINES IN THE UNITED STATES, BY CAUSES AND STATES.

State.	Period. <sup>a</sup>	Direct contact with trolley wire.							Tool or iron bar striking trolley wire.	Contact with mining machine.	Contact with machine feed wire.	Repairing line wires.	Miscellaneous.	Total.
		While climbing on car or motor.	While riding on car or motor.	Replacing trolley pole.	Falling or walking against wire.	Stepping on fallen wire.	Repairing guard boards.	Others.						
Alabama.....	1905-1913												48	48
Arkansas.....	1913												0	0
Colorado.....	1901-1913							9		3			8	20
Georgia.....	1913												0	0
Illinois.....	1903-1913	1	3		3	1		7		3			3	25
Indiana.....	1903-1913	1						3		1			1	7
Iowa.....	1909-1913												1	1
Kansas.....	1905-1913												1	1
Kentucky.....	1906-1913		2		3			12		1			1	18
Maryland.....	1913												0	0
Michigan.....	1906-1913												3	5
Missouri.....	1912-1913				1			1						2
Montana.....	1906-1913				1									1
New Mexico.....	1899-1913									1				1
North Dakota.....	1913													0
Ohio.....	1896-1913							28	4	2	21	1	7	63
Oklahoma.....	1898-1913		3							1	2	1	3	10
Oregon.....	1913													0
Pennsylvania (anthracite).....	1898-1913	1	2		6	1	2	3	1		4	2	1	34
Pennsylvania (bituminous).....	1896-1913	34	11	9	75		2	22	34	13	58	1	7	284
Tennessee.....	1903-1913							10		1	5			17
Texas.....	1909-1913													1
Utah.....	1911-1913								1				1	2
Virginia.....	1909-1913													0
Washington.....	1906-1913	3	1	1	1	1	1	6	3				14	14
West Virginia.....	1899-1913	8	11	5	4			48	9	3	30	4	3	118
Wyoming.....	1908-1913	1			1						1			133
Total.....		49	34	15	95	3	5	148	52	28	131	8	14	710
Percentage of total.....		6.90	4.79	2.11	13.38	.42	.70	20.85	7.33	3.94	18.45	1.13	1.97	100.00

<sup>a</sup> The first date indicates the first recorded fatality due to electricity and not the date of the introduction of electricity into the mines.

TABLE 59.—FATALITIES DUE TO ELECTRICITY IN THE COAL MINES OF GREAT BRITAIN, 1904-1913. <sup>a</sup>

Year.	Igni- tion of fire damp.	Mine fires.	Fatali- ties from electric shocks on surface.	Fatalities from electric shocks underground as a result of—						Total fatali- ties from electric shock.	Shock fatalities according to voltage.				
				Faults as regards grounding of outer coverings of appa- ratus.			Contact, direct or indirect, with live parts of cables.				Acci- dental contact with uninsu- lated live parts of appa- ratus.	Other causes.	250 volts or less.	250 to 650 volts.	Above 650 volts.
				Total absence of con- nection to earth.	Break in contin- uity of earth con- nec- tion.	Outer covering grounded, but con- nection ineffec- tuent.	Direct contact due to abrasion of insu- lation.	Contact with a conductor made live by its contact with cable.							
1904.	(b)	(b)	2	.....	.....	.....	.....	.....	7	.....	(b)	(b)	(b)		
1905.	(b)	(b)	3	.....	.....	.....	.....	.....	5	.....	(b)	(b)	(b)		
1906.	(b)	(b)	.....	.....	.....	.....	.....	.....	5	.....	(b)	(b)	(b)		
1907.	(b)	(b)	.....	.....	.....	.....	.....	.....	10	.....	(b)	1	(b)		
1908.	(b)	(b)	4	.....	.....	.....	.....	.....	15	.....	(b)	(b)	(b)		
1909.	(b)	(b)	.....	.....	.....	.....	.....	.....	13	.....	(b)	(b)	(b)		
1910.	9	1	4	.....	.....	.....	.....	.....	23	.....	(b)	5	2		
1911.	.....	1	4	1	2	3	1	.....	20	.....	(b)	10	3		
1912.	3	.....	4	2	1	3	4	.....	11	.....	(b)	7	2		
1913.	.....	.....	3	3	.....	3	1	.....	11	.....	(b)	8	1		
	.....	.....	.....	.....	.....	.....	.....	.....	16	.....	.....	11	2		

<sup>a</sup> Great Britain mines and quarries, general report and statistics, pt. 2.<sup>b</sup> Not given.<sup>c</sup> Report states "majority" of fatalities due to this voltage.

In Table 59 is given a classification of accidents due to electricity as compiled from the coal-mine inspectors' reports of Great Britain. The majority of the fatalities were caused by alternating current at voltages ranging from 250 to 650. It is to be expected that the majority of the accidents should be within this range of voltage, as it is used almost exclusively at the mines.

TABLE 60.—NUMBER OF MEN KILLED BY **SHAFT ACCIDENTS** IN AND ABOUT THE COAL MINES OF THE UNITED STATES, BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.<sup>a</sup>

State.	Period ending 1913.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total killed in shafts.	Percentage of total killed.	Number killed per 1,000 employed.
		13	14	15	16			
	<i>Years.</i>							
Alabama.....	51	5	2	1	.....	8	0.43	0.02
Alaska and California.....	4	.....	.....	.....	.....	0	.....	.....
Arkansas.....	9	.....	.....	.....	2	2	1.87	.05
Colorado.....	28	17	3	14	2	36	2.07	.15
Georgia and North Carolina.....	5	.....	.....	.....	.....	0	.....	.....
Idaho and Nevada.....	4	.....	.....	.....	.....	0	.....	.....
Illinois.....	29	115	28	117	0	266	7.80	.20
Indiana.....	19	31	2	36	2	71	10.46	.23
Iowa.....	26	35	6	22	2	65	9.00	.20
Kansas.....	21	19	6	25	.....	50	9.47	.23
Kentucky.....	26	10	5	9	.....	24	3.78	.08
Maryland.....	23	.....	.....	.....	.....	0	.....	.....
Michigan.....	14	2	2	6	.....	10	10.20	.22
Missouri.....	26	9	1	17	.....	27	7.14	.13
Montana.....	14	.....	.....	1	.....	1	.63	.03
New Mexico.....	21	.....	.....	1	.....	0	.....	.....
North Dakota.....	6	.....	.....	.....	1	0	.....	.....
Ohio.....	30	33	6	39	1	79	3.45	.08
Oklahoma.....	21	5	3	14	3	25	3.43	.19
Oregon.....	5	.....	.....	.....	.....	0	.....	.....
Pennsylvania (anthracite).....	44	520	105	211	7	843	4.76	.16
Pennsylvania (bituminous).....	36	104	19	90	4	217	2.29	.06
Tennessee.....	23	1	.....	.....	.....	1	.12	.....
Texas.....	5	.....	.....	.....	1	1	4.00	.04
Utah.....	22	2	.....	1	.....	3	.84	.08
Virginia.....	5	1	.....	.....	.....	1	.40	.03
Washington.....	25	6	3	2	2	13	2.03	.12
West Virginia.....	29	43	2	22	.....	67	1.41	.07
Wyoming.....	6	.....	.....	1	.....	1	.41	.02
<b>Total.....</b>		<b>958</b>	<b>193</b>	<b>628</b>	<b>32</b>	<b>1,811</b>	<b>3.74</b>	<b>.12</b>

<sup>a</sup> This table is based on Table 5, and is for periods indicated, by States for which continuous records are available. It does not necessarily check with Tables 3 and 4 for the reason that the latter tables include intermittent records prior to the period having continuous records.

### MINE SHAFTS.

Table 60 shows the number of fatalities, by States, due to accidents at shafts and subdivided into four different groups, as falling down shafts, objects falling down shafts, cages or skips, and miscellaneous. During the period represented 1,811 were killed by shaft accidents, of which number 843 occurred in and about the anthracite mines. The large number of fatalities at the anthracite mines is not exceptional for the reason that practically all of the mines are opened by



shafts, whereas in the bituminous mines, except some in the Central and Western States, the majority of the mines are opened by slopes and drifts. During 36 years only 217 were killed by reason of shaft accidents at the Pennsylvania bituminous mines, while in Illinois during the 29-year period 266 men were thus killed. The average number of men employed per year in the Pennsylvania bituminous mines is about twice the number employed at the Illinois mines (Table 7), showing that the high Illinois rate, which is more than three times as high as at the bituminous mines of Pennsylvania, is due to the fact that the mines are operated through shafts instead of slopes and drifts. The Illinois mines are more nearly comparable with the anthracite mines in this respect.

More than one-half of all fatalities at shafts are due to persons falling down the shaft, either from the surface or from the various landings. Cages and skips are responsible for slightly over one-third of the shaft accidents. These two causes offer a good field for safety work, and, as shown in Table 4 and figure 1, the accidents at coal-mine shafts are being reduced by reason of vigilance on the part of the inspectors and the installation of safety devices by the operators.

#### SURFACE SHOPS AND YARDS.

Table 61 shows the number of men killed at surface works about coal mines in the United States during continuous periods as indicated including 1913. The fatalities recorded in this table do not include accidents to coke-oven workers, as these have been eliminated in every case where sufficient information was given to identify the victim with the coking industry. The number of surface fatalities as shown is 3,573, representing 7.37 per cent of the total number killed in and about the mines. The rate per 1,000 men employed is 0.24. Of the total number killed 2,321 were at the surface workings of the anthracite mines and a large percentage of these were killed in the breakers. The accidents in the breakers have been included by reason of the fact that this is one of the branches of the industry which is absolutely necessary to prepare the coal for the market. The coke-oven fatalities of the bituminous field were eliminated for the reason that they are considered foreign to the preparation of the coal for market. It is a second step in which the coal, so to speak, is manufactured into another product.

Almost one-half of the surface fatalities are due to mine cars and locomotives and railway cars and locomotives, thus pointing out the need for closer supervision and better equipment of haulage systems. Boiler explosions and bursting steam pipes are responsible for 214 fatalities. Machinery claimed 775 victims, 629 of which were at the anthracite mines and include many breaker accidents.

TABLE 61.—NUMBER OF MEN KILLED BY SURFACE ACCIDENTS ABOUT THE COAL MINES OF THE UNITED STATES BY STATES, DURING PERIOD SHOWN ENDED DEC. 31, 1913, FOR WHICH CONTINUOUS RECORDS ARE AVAILABLE.<sup>a</sup>

State.	Period ending 1913.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total killed on surface.	Percentage of total killed.	Number killed per 1,000 employed.
		17	18	19	20	21	22			
	<i>Years.</i>									
Alabama.....	21			11	2	5	10	28	1.50	0.08
Alaska and California.....	4							0		
Arkansas.....	9			1				1	.94	.02
Colorado.....	28	21	1	3	3	7	14	49	2.82	.20
Georgia and North Carolina.....	5							0		
Idaho and Nevada.....	4							0		
Illinois.....	29	5	1	26	15	56	31	134	3.93	.10
Indiana.....	19	2			1	10	3	16	2.36	.05
Iowa.....	26	3			6	7	3	19	2.63	.06
Kansas.....	21	1		2	1	8	5	17	3.22	.08
Kentucky.....	26	23		2	3	9	10	47	7.40	.15
Maryland.....	23	12		1		4	5	22	10.00	.19
Michigan.....	14				2	1	2	5	5.10	.11
Missouri.....	26	1		1		1	1	4	1.06	.02
Montana.....	14			3		3	3	9	5.66	.22
New Mexico.....	21	2			1		1	4	.70	.08
North Dakota.....	6							0		
Ohio.....	30	22	2	6	18	20	19	87	3.80	.09
Oklahoma.....	21	4		2	1	1	9	17	2.33	.13
Oregon.....	5							0		
Pennsylvania (anthracite).....	44	669	8	629	118	228	669	2,321	13.10	.45
Pennsylvania (bituminous).....	36	161	14	57	35	46	92	405	4.28	.12
Tennessee.....	23	21		1		3	7	33	3.84	.16
Texas.....	5	1						1	4.00	.04
Utah.....	22	6	1	2	1	3	2	15	4.23	.39
Virginia.....	5	8	1			3	6	18	7.17	.46
Washington.....	25	12		9	3	1	10	35	5.47	.33
West Virginia.....	29	156	13	19	2	28	61	279	5.88	.29
Wyoming.....	6	3			1	2	1	7	2.91	.15
<b>Total.....</b>		<b>1,133</b>	<b>41</b>	<b>775</b>	<b>214</b>	<b>446</b>	<b>964</b>	<b>3,573</b>	<b>7.37</b>	<b>.24</b>

<sup>a</sup> This table is based on Table 5, and is for periods indicated, by States for which continuous records are available. It does not necessarily check with Tables 3 and 4, for the reason that the latter tables include intermittent records prior to the period having continuous records.

### ACCIDENTS CLASSIFIED BY OCCUPATION.

Data for mine accidents as related to the occupation of the employee are far from complete. Many of the mine inspectors' reports give the occupation of the man who has been fatally injured, and from these reports it is an easy matter to actually compile figures for certain States showing the total number killed in each occupation. However, these reports, with but one or two exceptions, fail to give the actual number of men employed in the specified occupations, and since data of this character are lacking, it is not possible to arrive at any true comparative hazards for the various occupations. The fatality figures may show a larger number of men killed in one occupation, possibly ten times as many, than in some other class of work. At the same time, there may be twenty times as many men engaged in this particular work, so that the hazard would not be as great as indicated by the actual number of men killed. For example, there are rela-

tively few shot firers in the mines as compared with other underground employees, and the actual number of shot firers killed is therefore much smaller than in some other occupations, yet it is an extremely hazardous occupation. To obtain the relative hazard of each occupation the number engaged therein is necessary.

Mine inspectors' reports for the State of Pennsylvania from 1902 to 1913, inclusive, show both the number of men killed in certain of the principal occupations and the corresponding number of men employed therein. Table 62 shows fatalities by occupations in the anthracite mines from 1881 to 1913, inclusive. The corresponding number of men employed, however, is shown only for miners and

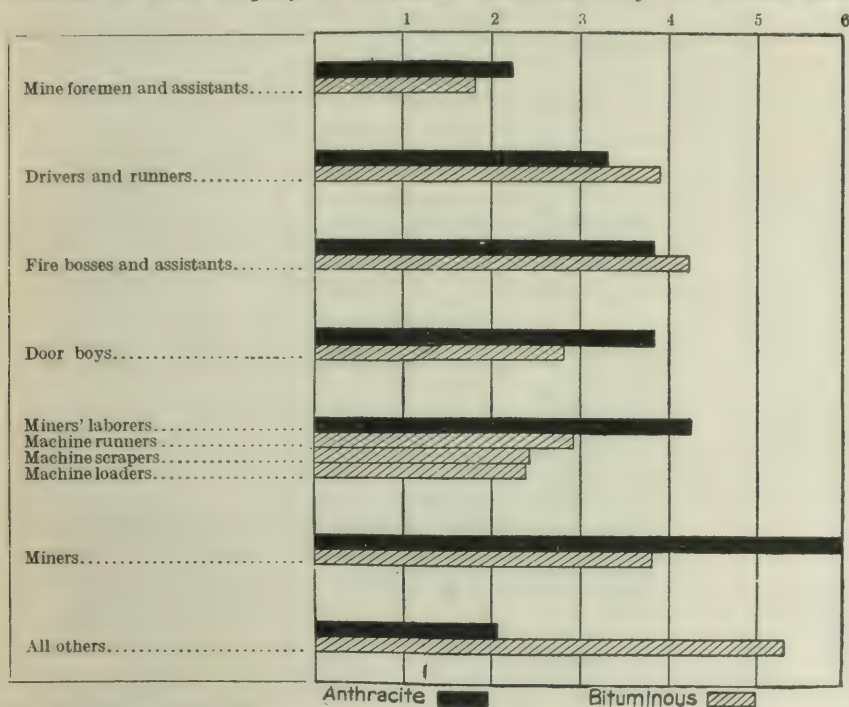


FIGURE 6.—Average number of men killed per thousand employed in anthracite and bituminous mines of Pennsylvania, by occupation, 1902-1913. (Based on Tables 62 and 63.)

miners' laborers. Beginning with 1900 complete figures to and including 1913 are given for the number killed, as well as the number employed in the various occupations. The highest fatality rate is for the anthracite miners, which averages for the period 1900 to 1913, 6 per 1,000 men employed. The fatality rate for the miners' laborers is 4.29 per 1,000 employed. The fatality rate for fire bosses and assistants is 3.86, as compared with 4.29 in the bituminous mines. The rate for mine foremen and assistants is also higher, being 2.28 as against 1.86 in the bituminous mines. The relative occupational hazards for the two periods covered, for both the anthracite and bituminous coal mines of Pennsylvania, are graphically shown in figure 6.



TABLE 62.—NUMBER OF MEN EMPLOYED, NUMBER KILLED PER 1,000 EMPLOYED, BY OCCUPATION, UNDER GROUND, IN THE ANTHRACITE COAL MINES OF PENNSYLVANIA, 1881 TO 1913, INCLUSIVE.<sup>a</sup>

[See fig. 6.]

Year.	Mine foremen and assistants.			Fire bosses and assistants.			Miners.			Miners' laborers.			Drivers and runners.			Door boys, etc.			All other underground employees.		
	Number employed.	Number killed.		Number employed.	Number killed.		Number employed.	Number killed.		Number employed.	Number killed.		Number employed.	Number killed.		Number employed.	Number killed.		Number employed.	Number killed.	
		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.		Total.	Per 1,000 employed.
1881.....	.....	.....	.....	.....	.....	.....	22,809	114	5.00	16,726	70	4.19	.....	28	.....	.....	.....	.....	.....	4	.....
1882.....	.....	3	.....	.....	135	5.91	22,843	135	5.91	15,229	56	3.68	.....	28	.....	.....	.....	.....	.....	14	.....
1883.....	.....	1	.....	.....	136	5.37	25,219	136	5.37	16,879	67	3.97	.....	47	.....	.....	.....	.....	.....	14	.....
1884.....	.....	1	.....	.....	27,100	132	4.87	19,605	81	4.13	86	4.27	.....	28	.....	.....	.....	.....	.....	30	.....
1885.....	.....	.....	.....	.....	28,305	160	5.65	20,128	86	4.27	86	4.27	.....	16	.....	.....	.....	.....	.....	19	.....
1886.....	.....	2	.....	.....	25,970	131	5.04	17,068	68	3.98	57	3.25	.....	18	.....	.....	.....	.....	.....	9	.....
1887.....	.....	.....	.....	.....	29,558	102	3.45	17,548	57	3.25	57	3.25	.....	23	.....	.....	.....	.....	.....	72	.....
1888.....	.....	1	.....	.....	34,547	169	4.89	21,952	87	3.96	33	3.33	.....	10	.....	.....	.....	.....	.....	10	.....
1889.....	.....	1	.....	.....	30,504	191	6.26	19,368	79	4.08	33	3.33	.....	9	.....	.....	.....	.....	.....	16	.....
1890.....	.....	4	.....	.....	28,936	146	5.05	18,620	95	5.10	37	3.77	.....	10	.....	.....	.....	.....	.....	11	.....
1891.....	.....	.....	.....	.....	30,779	180	5.85	19,590	119	6.07	38	3.88	.....	8	.....	.....	.....	.....	.....	31	.....
1892.....	.....	3	.....	.....	30,552	180	5.89	22,110	111	5.02	47	4.70	.....	7	.....	.....	.....	.....	.....	22	.....
1893.....	.....	1	.....	.....	32,881	195	5.93	22,853	108	4.73	38	3.80	.....	12	.....	.....	.....	.....	.....	16	.....
1894.....	.....	1	.....	.....	33,357	218	6.54	23,942	91	3.80	38	3.80	.....	8	.....	.....	.....	.....	.....	15	.....
1895.....	.....	3	.....	.....	34,553	179	5.18	24,638	115	4.67	33	3.33	.....	2	.....	.....	.....	.....	.....	14	.....
1896.....	.....	.....	.....	.....	37,003	204	5.51	26,530	134	5.03	46	4.67	.....	10	.....	.....	.....	.....	.....	29	.....
1897.....	.....	.....	.....	.....	35,932	210	5.69	27,277	90	3.29	26	2.60	.....	4	.....	.....	.....	.....	.....	28	.....
1898.....	485	.....	10.31	808	.....	4.95	35,377	176	4.94	24,060	124	5.13	10,267	33	3.21	3,072	1.95	16,103	.....	28	0.75
1899.....	.....	2	.....	.....	38,421	169	4.40	23,946	114	4.76	39	3.88	.....	6	.....	.....	.....	.....	.....	15	.....
1900.....	519	.....	6.19	808	.....	6.19	36,832	184	5.00	24,613	95	3.84	10,177	33	3.24	3,128	2.56	18,063	.....	33	1.83
1901.....	539	.....	9.26	820	.....	9.41	37,804	224	5.93	26,265	122	4.64	10,894	45	4.13	3,148	6	1.91	18,951	37	1.95
1902.....	648	.....	3.09	824	.....	2.64	36,392	114	3.12	26,443	122	4.44	10,595	27	2.55	3,308	5	1.51	21,102	32	1.52
1903.....	666	.....	4.59	841	.....	2.98	36,822	204	5.56	27,533	110	4.00	11,251	46	4.09	3,087	12	3.80	21,854	51	2.33
1904.....	703	.....	1.11	901	.....	1.11	39,848	233	5.82	31,217	145	4.63	11,607	31	2.67	3,173	20	6.30	22,913	63	2.75
1905.....	724	.....	1.36	932	.....	1.15	43,078	308	7.12	31,967	148	4.63	12,069	31	2.57	3,284	14	4.26	25,307	47	1.78
1906.....	740	.....	2.67	983	.....	6.10	41,800	226	5.41	31,652	133	3.43	11,889	32	2.69	2,919	19	3.08	27,005	48	1.78
1907.....	868	.....	2.18	917	.....	2.18	43,035	309	7.18	29,984	136	4.54	11,810	46	3.90	2,711	18	6.64	28,524	88	3.09
1908.....	1,190	.....	2.54	658	.....	4.56	44,340	313	7.06	32,853	136	4.69	11,968	49	4.09	2,970	18	6.05	30,264	56	1.85
1909.....	1,203	.....	2.83	684	.....	2.92	44,675	264	5.91	32,232	126	3.91	11,960	37	3.09	3,026	11	3.64	29,492	49	1.66
1910.....	1,252	.....	1.60	707	.....	2.83	45,651	294	5.82	32,040	147	4.59	11,589	40	3.45	2,432	6	2.47	29,871	58	1.94

1911.....	1,301	2	1.54	762	5	6.56	45,324	306	6.75	32,905	176	5.35	11,656	45	3.40	2,421	15	6.20	31,468	66	2.08
1912.....	1,289	1	1.77	782	1	1.28	44,696	262	5.86	33,438	117	3.50	11,479	42	3.66	2,449	8	3.27	33,664	67	1.99
1913.....	1,510	3	1.99	778	8	10.28	44,346	286	6.45	33,973	148	4.36	11,463	33	2.88	2,611	7	2.64	33,986	72	2.12
<b>Total (1900-1913)</b>	<b>13,171</b>	<b>30</b>	<b>2.28</b>	<b>11,407</b>	<b>44</b>	<b>3.86</b>	<b>591,645</b>	<b>3,467</b>	<b>6.00</b>	<b>424,115</b>	<b>1,819</b>	<b>4.29</b>	<b>180,407</b>	<b>537</b>	<b>3.35</b>	<b>40,667</b>	<b>157</b>	<b>3.86</b>	<b>372,664</b>	<b>767</b>	<b>2.46</b>

<sup>a</sup> Compiled from annual reports of the Department of Mines, Harrisburg, Pa.

TABLE 63.—NUMBER OF MEN EMPLOYED AND NUMBER KILLED, CLASSIFIED BY OCCUPATION, IN THE BITUMINOUS MINES OF PENNSYLVANIA, 1902 TO 1913.<sup>a</sup>

(See fig. 6.)

Year.	Mine foremen and assistants.			Fire bosses and assistants.			Miners.			Machine runners.			Machine loaders.			Machine scrapers.			Drivers and run-ners.			Door boys and helpers.			All others.		
	Number killed.			Number killed.			Number killed.			Number killed.			Number killed.			Number killed.			Number killed.			Number killed.			Number killed.		
	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.	Total.	Per 1,000 employed.	Number employed.
1902.....	1,197	4	3.34	427	7	16.39	59,025	314	5.32	2,940	13	4.42	25,796	35	1.36	2,942	10	3.40	8,061	23	2.85	1,893	2	1.06	7,679	34	4.43
1903.....	1,327	1	1.75	494	3	6.07	66,086	236	3.57	3,276	10	3.03	28,479	48	1.69	3,013	5	1.46	7,788	29	3.41	1,872	3	2.57	9,639	28	2.90
1904.....	1,307	1	1.77	351	2	3.60	62,248	201	3.23	3,717	16	4.30	38,344	142	3.73	3,471	12	3.17	7,498	30	4.04	1,712	6	3.50	9,635	38	3.97
1905.....	1,372	2	1.46	391	5	8.46	66,814	261	3.91	3,816	13	3.41	38,169	107	2.79	3,862	13	3.36	9,421	37	4.01	1,911	3	1.64	10,375	38	3.61
1906.....	1,478	3	2.03	654	4	6.12	69,346	247	3.56	4,109	7	1.70	38,826	172	4.41	4,001	8	2.08	10,646	77	2.42	2,038	3	1.13	11,677	36	3.01
1907.....	1,566	3	1.29	741	8	10.87	72,329	352	3.02	4,132	19	4.53	40,841	172	4.21	4,831	8	2.00	10,712	82	2.72	2,172	22	1.94	13,015	94	7.11
1908.....	1,553	2	2.06	863	4	4.38	41,976	169	3.93	4,297	11	2.60	41,976	169	3.64	4,022	6	1.46	10,042	82	3.40	2,012	5	2.02	13,196	129	9.40
1909.....	1,464	3	2.06	739	3	4.09	46,996	199	4.25	4,592	17	3.54	46,996	199	4.25	4,162	1	0.21	10,256	41	3.49	1,945	6	2.57	14,190	65	4.60
1910.....	1,541	3	1.95	771	1	1.09	73,771	285	3.89	4,826	12	2.57	47,190	104	2.21	4,182	11	2.63	10,719	31	3.19	1,898	6	3.16	15,321	65	4.01
1911.....	1,813	0	1.46	897	2	2.17	60,964	216	3.53	4,315	15	3.26	47,660	143	2.90	4,188	12	2.87	10,072	34	3.84	1,597	2	1.31	17,211	84	5.11
1912.....	2,036	2	3.60	975	1	1.03	59,986	254	4.23	4,608	15	3.26	54,026	134	2.48	4,312	13	3.01	10,659	41	3.85	1,387	4	2.88	18,101	91	5.63
<b>Total</b>	<b>18,795</b>	<b>35</b>	<b>1.86</b>	<b>9,098</b>	<b>39</b>	<b>4.29</b>	<b>803,241</b>	<b>3,078</b>	<b>3.83</b>	<b>48,149</b>	<b>141</b>	<b>2.93</b>	<b>493,555</b>	<b>1,193</b>	<b>2.42</b>	<b>45,667</b>	<b>112</b>	<b>2.45</b>	<b>115,765</b>	<b>459</b>	<b>3.96</b>	<b>21,851</b>	<b>63</b>	<b>2.88</b>	<b>157,071</b>	<b>941</b>	<b>5.35</b>

<sup>a</sup> Compiled from annual reports of the Department of Mines, Harrisburg, Pa.

Table 63 shows the number of men employed and number killed, classified by occupations, in the bituminous mines of Pennsylvania from 1902 to 1913, inclusive. During the 12-year period the fatality rate for miscellaneous employees was 5.35 per 1,000 men employed; fire bosses, 4.29; drivers and runners, 3.96; and miners, 3.83.

#### NONFATAL INJURIES IN COAL MINES IN THE UNITED STATES.

There are no complete records of the nonfatal injuries at the coal mines in the United States. In 1911 the bureau collected direct from the operators statistics relating to nonfatal injuries for that year. The number of serious <sup>a</sup> injuries reported was 9,106 and of slight injuries, 22,228. These reports were doubtless incomplete, as many of the mining companies were not keeping complete records of all accidents at their mines. Furthermore, there were but few compensation laws in effect which compelled the operators to keep records of nonfatal injuries.

The number killed per 1,000 employed in the metal mines is less than in the coal mines when compared on an equal time basis of 300-day workers. In view of this fact there is no reason to believe that the number of nonfatal injuries should be less in the coal mines than in the metal mines.

The best figures available on this subject are those collected by the United States Bureau of Mines for the metal-mining industry. The bureau has issued reports covering a period of four years, 1911 to 1914, in which the number of nonfatal accidents reported represent about 30 per 1,000 wherein the injured person was off duty 20 days or more by reason of disability. The bureau's reports show that approximately 150 men per 1,000 received minor injuries resulting in a disability varying from 1 to 20 days. These figures are based upon voluntary reports of the mining companies to the Bureau of Mines. Since there is no Federal law requiring these reports, it is believed that the above rates are too low. This view is supported by a special study of metal-mine accidents for 1914, which contains the reports of 258 companies whose accident records are reasonably complete. The study shows that 50 per 1,000 are seriously injured (disabled 20 days or more), while 270 per 1,000 are slightly injured (disabled 1 to 20 days). These injuries, however, apply only to, and are based on, 75,000 men employed either underground or in the open-pit mines, excluding all surface, shop, and mill men. Taking the average metal-mine rate for a period of four years as a basis of injuries in the coal mines, there would be approximately 22,900 persons seriously injured and 114,500 persons slightly injured each year.

<sup>a</sup> Serious injuries include those causing a loss of time of 20 days or more. A slight injury is one causing a loss of more than one day but less than 20.



In 1911 two-thirds of the serious and slight injuries in the coal mines were due to falls of roof and pillar coal and mine cars and locomotives. About one-half of the nonfatal injuries in the metal mines were due to these two causes, showing that there are more injuries in the coal mines from them than in the metal mines. The coal mines have a much larger area of roof exposed than do the metal mines, and in most cases the haulage system is more extensive by reason of the longer haul and the excess tonnage handled, thus increasing the coal-mine hazard as compared with metal mines. These being the principal causes of nonfatal injuries, there seems reason to believe that the above estimate is too low rather than too high.

Tables 64, 65, and 66 show the injuries as reported by the State mine inspectors in their latest published reports for the States indicated. These tables represent 6,719 injuries, which have been classified according to the part of the body injured, and also by causes. The accidents are also tabulated by States with reference to the part of the body injured and the cause of the injury. These tables are far from being complete, inasmuch as they represent only the more serious injuries. For example, the report for Illinois includes only those accidents in which the injury resulted in a loss of 30 days' time or more. In some of the States no time is specified and no statement given to indicate what class of injuries is included in the report.

These tables will be of some assistance to the hospital department of the various coal mines, inasmuch as they point out the part of the body receiving the most injuries and will give the surgeons and others an idea as to the surgical equipment necessary to properly take care of the injuries to be expected in and about the coal mines.

NUMBER AND PERCENTAGE OF INJURIES RECEIVED BY MEN EMPLOYED IN AND ABOUT COAL MINES, BY PARTS INJURED.

[See also fig. 7.]

	Number.	Percentage.
Head.....	427	6.36
Face.....	290	4.32
Shoulders.....	330	4.91
Arms.....	544	8.10
Hands.....	948	14.11
Body.....	1,190	17.71
Hip and pelvis.....	281	4.18
Legs.....	1,987	29.57
Feet.....	722	10.74
Total.....	6,719	100.00

With the enactment of compensation laws in the various States, it is hoped that in the near future there will be more complete data available to afford a basis for a detailed study of nonfatal injuries.

However, sufficient data concerning fatal injuries have been collected and tabulated herein to form a basis for an intensive study of the various accidents by causes. Any safety device, rule, regulation, law, or instruction to miners that will reduce fatal accidents will also reduce the nonfatal accidents. The difference between the two

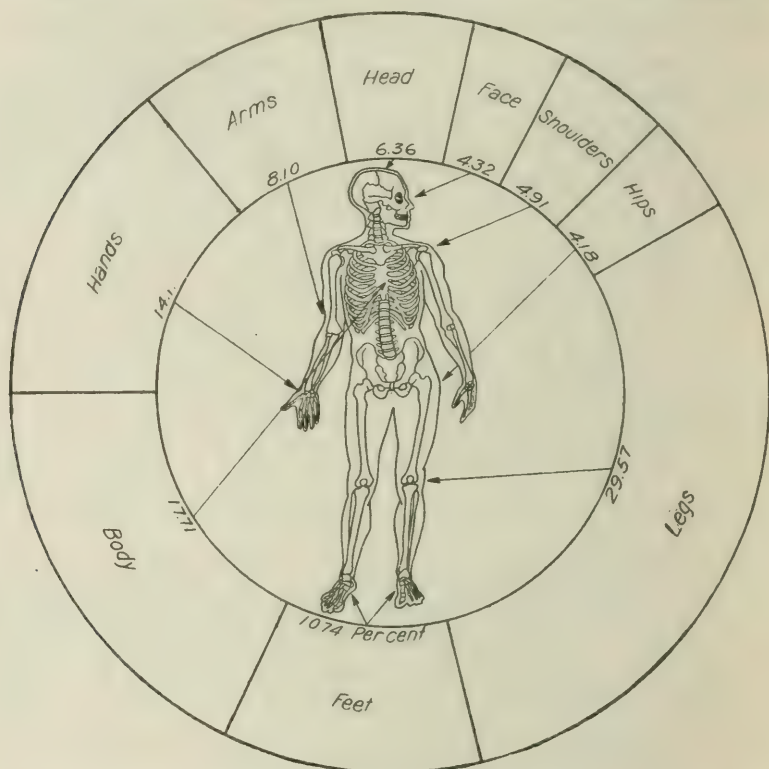


FIGURE 7.—Analysis of nonfatal injuries showing part of body injured and percentage for each location.  
(Based on Table 66.)

classes of accidents is only one of degree or severity. The cause still remains the same: fall of rock, mine car, or explosive. If a falling rock strikes a man on the head or body it may kill him, but if it strikes only his foot or hand, seriously injuring him, the cause, fall of rock, is the same. By removing the cause of fatal accidents, the number of nonfatal accidents will be greatly reduced.

TABLE 64.—NUMBER AND CAUSES OF NONFATAL INJURIES IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING 1913 OR NEAREST YEAR FOR WHICH RECORDS ARE AVAILABLE, BY STATES.<sup>a</sup>

[Data not available for States not listed.]

State.	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Falls of persons.	Falling objects (other than a and b).	Flying objects.	Rush of coal or gob in chute or bin.	Hand tools.	Machinery.	Ropes and cables.	Cages or skips.	Boilers and steam pipes.	Lifting (strains).	Timber.	Railroad cars.	Nails and splinters.	Running into or against objects.	Explosions of oil or gasoline.	Total.
Arkansas.....	32	2	30	13	4	4			2	4		4	5	21		2	1		13	2	2	1					102
Illinois.....	145	144	145	12	9	29		2	22	18		22	13	3	14	4			6	2	13	28		1	4		647
Indiana.....	112	28	145	12	11	11		1	22	18		22	13	3	5	1			6	2	13	4		1	1		406
Iowa.....	67	18	52	18	3	3		1	10	2		6	2	2	3				1	3	3	2					164
Kansas.....	120	19	140	28	17	17		3	5	2		3	3	8	2				2	1	1	4					369
Maryland.....	46	15	48	1	1	1			4	1		5	3		2				1		1	4					144
Missouri.....	36	7	19	1					4	1		5	3		1						1	4					70
Montana.....	38	17	38		4	4				1			1		1							2					95
North Dakota.....	2	7	3																								25
Ohio.....	240	45	173	5	8	13		4	10	47		5	2	3	1				3	1		6					578
Oklahoma.....	27	4	26	6	2	2			3	3				1	1				1	1	1	6					85
Pennsylvania (anthracite).....	262	104	296	88	95	2		2	26	2		37	10	5	9				6	2	1	32			2		1,015
Pennsylvania (bituminous).....	419	158	339	4	1	48		2	14	38		14	7	2	2				3	3	1	2			2		1,076
Texas.....	7	4	20	1	1	1			3	1		3	3	1	2				2	2	1	1			3		47
Utah.....	1	1	24						3	4		3			1						1	1					50
Virginia.....	81	25	114	2	6	1		1	3	2		3	13	3	19				3	1	1	16			12		347
Washington.....	225	89	124	28	8	2		4	7	3		56	12	59	11				2	32	2	2			13		830
West Virginia.....	243	72	240	6	32			1	7	31		9	5						1	1	1	2			6		969
Total.....	2,095	765	1,992	205	3	281	3	34	163	167		181	79	108	11	149	98	17	51	26	65	159	23	32	16	6	6,719

<sup>a</sup> Compiled from State mine inspector's reports. These figures represent only the more serious injuries, the minimum range of disability being 7 to 30 days. They are not uniform for the various States, simply being all that were published in the various inspectors' reports during a period of one year.





Shoulder injured.....	4	15	11	5	7	4	4	2	1	27	1	7	10	.....	.....	11	32	.....	11	151
Body injured.....	6	53	9	5	5	3	0	5	12	24	8	11	14	.....	.....	10	43	.....	2	40
Body burned.....	4	7	13	5	1	1	.....	.....	.....	1	1	24	4	.....	.....	3	1	.....	19	297
Rib broken.....	1	7	13	5	1	1	2	.....	.....	6	2	12	4	.....	.....	2	8	.....	4	63
Ribs broken.....	3	9	13	5	2	8	3	2	.....	12	4	40	33	.....	.....	1	10	.....	7	83
Back injured.....	10	52	23	6	38	19	2	2	.....	47	11	45	42	.....	.....	21	76	.....	19	176
Back broken.....	1	4	22	0	3	1	2	5	.....	30	2	23	17	.....	.....	13	19	.....	48	453
Hip or hips injured.....	4	21	22	0	3	2	2	.....	1	2	2	3	5	.....	.....	1	2	.....	3	231
Hip or hips broken.....	3	3	3	1	.....	.....	.....	.....	.....	1	8	9	8	.....	.....	1	2	.....	2	26
Pelvis broken.....	4	21	21	14	33	15	6	7	.....	59	8	27	47	.....	.....	20	69	.....	18	34
Leg injured.....	8	49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	402
Leg broken.....	3	67	53	28	8	6	5	26	1	62	7	285	1	.....	.....	16	14	.....	196	1,149
Leg lost.....	2	4	1	2	.....	.....	.....	.....	.....	5	2	2	3	.....	.....	1	3	.....	7	18
Legs injured.....	.....	.....	.....	1	.....	2	.....	.....	.....	3	1	12	16	.....	.....	1	.....	.....	4	41
Legs broken.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Leg lost.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Knee injured.....	11	11	3	2	30	.....	.....	.....	.....	6	1	4	3	.....	.....	7	34	.....	5	101
Foot injured.....	8	50	23	10	39	22	4	8	2	43	4	24	34	.....	.....	60	73	.....	34	471
Foot broken.....	1	21	11	4	2	.....	1	3	.....	3	3	3	12	.....	.....	1	2	.....	12	84
Foot lost.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	10	21
Feet injured.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	4	9
Feet broken.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Feet lost.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Ankle injured.....	3	19	9	4	22	3	1	2	.....	22	1	6	16	.....	.....	10	32	.....	7	158
Ankle broken.....	8	8	3	2	.....	1	1	.....	.....	2	.....	19	26	.....	.....	1	1	.....	18	87
Ankles injured.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Ankles broken.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0
Toe injured.....	7	7	.....	1	3	2	.....	.....	.....	6	1	2	5	.....	.....	.....	10	.....	1	42
Toe broken.....	.....	.....	.....	1	2	.....	.....	.....	.....	1	.....	2	5	.....	.....	2	5	.....	2	28
Toe lost.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	2	7	.....	.....	1	.....	.....	6	24
Toes injured.....	7	7	1	1	1	1	1	.....	.....	2	1	3	.....	.....	.....	.....	2	.....	2	27
Toes broken.....	2	1	1	1	.....	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	13
Toes lost.....	1	1	1	1	2	.....	.....	1	.....	5	1	12	13	.....	.....	1	4	.....	4	13
Internal injuries.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rupture (hernia).....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	102	647	406	164	369	144	70	95	25	578	85	1,015	1,076	47	50	347	830	689	6,719	

<sup>a</sup> See footnote, Table 64.

TABLE 66.—NUMBER AND CAUSES OF NONFATAL INJURIES, SHOWING PARTS OF BODY INJURED, IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING 1913 OR NEAREST YEAR FOR WHICH RECORDS ARE AVAILABLE.<sup>a</sup>

Part of body injured.	Cause of injury.																									Total.
	a	q	c	p	e	f	g	h	i	j	k	l	m	n	o	d	b	r	s	t	u	v	w	x	y	
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Falls of persons.	Falling objects (other than a and b).	Flying objects.	Rush of coal or gob in chute or bin.	Hand tools.	Machinery.	Ropes and cables.	Cages or skips.	Boilers and steam pipes.	Lifting (strains).	Timber.	Railroad cars.	Nails and splinters.	Running into or against objects.	Explosions of oil or gasoline.
Head injured.....	179	37	52	4	...	55	3	...	20	2	...	17	8	5	1	4	7	1	4	3	...	19	2	...	4	427
Face burned.....	...	...	...	54	1	28	...	7	...	...	...	...	1	82	1	2	1	...	...	2	...	3	...	1	1	84
Eye injured.....	16	5	1	...	...	4	4	1	3	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	121
Eye lost.....	1	...	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19
Eyes injured.....	...	...	...	...	...	8	8	1	...	...	...	...	...	2	1	...	...	...	...	...	...	...	...	...	...	10
Eyes lost.....	...	...	...	...	...	3	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	5
Nose broken.....	8	1	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18
Jaw broken.....	25	...	7	...	...	3	...	...	4	...	...	...	1	2	2	1	...	...	...	...	...	4	...	...	...	23
Collar bone broken.....	5	31	64	1	...	1	...	...	5	1	...	...	2	...	...	...	...	...	...	...	...	4	...	...	...	139
Arm injured.....	30	12	34	...	...	4	4	...	5	2	...	4	2	1	...	6	7	1	1	...	1	6	1	1	...	115
Arm burned.....	...	...	...	27	...	15	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	47
Arm broken.....	...	...	...	...	...	8	8	...	12	6	...	23	4	...	2	2	9	2	1	...	1	6	1	...	...	263
Arm lost.....	87	27	95	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14
Arms injured.....	3	1	5	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3
Arms broken.....	2	...	6	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11
Arms lost.....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
Wrist injured.....	7	2	12	...	...	...	...	...	...	...	...	...	4	...	...	7	...	...	...	...	1	...	...	...	...	34
Wrist broken.....	6	4	14	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...	...	...	...	...	37
Hand injured.....	51	16	99	...	...	7	7	1	1	1	...	3	5	2	1	25	9	2	1	4	...	8	1	3	...	241
Hand burned.....	...	...	...	80	2	44	...	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	143
Hand broken.....	...	...	...	...	...	1	...	...	2	1	...	...	1	...	...	...	...	...	...	...	...	1	...	...	1	20
Hand lost.....	5	1	3	...	...	7	...	...	...	...	...	...	3	1	...	...	...	...	...	...	...	...	...	...	...	13
Hands injured.....	1	1	3	1	...	1	1	1	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	9
Hands broken.....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
Hands lost.....	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1

Part of body injured.





## FATALITIES AT BITUMINOUS COAL MINES.

Inasmuch as bituminous coal mining differs so much from the mining of anthracite, Tables 67 and 68, covering the bituminous coal-mining industry from 1890 to and including 1914, have been

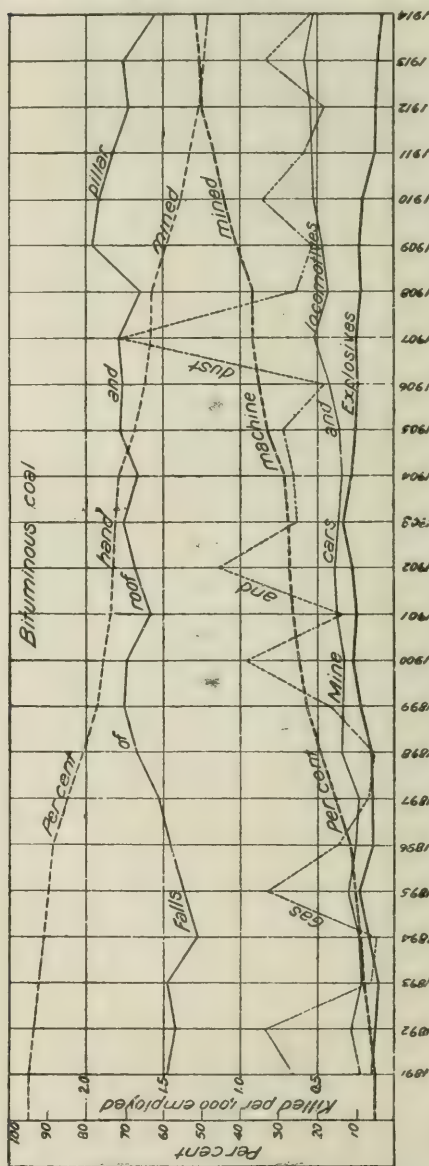


FIGURE 8.—Fatality rates, by principal causes, in bituminous coal mines of the United States, 1891-1914, as compared with the increase in the percentage of machine-mined coal. (Based on Table 68.)

compiled. Complete data prior to 1890 would be desirable, but for a study of present-day mine accidents it is believed that these tables go back sufficiently far to show the actual hazards of the bituminous mines.

The total production and the number of men employed in all bituminous mines of the United States are given in Table 67. In the second part of the same table are given the production and number of men employed in those States which are under inspection service and for which accident records are available. In 1890, 89.60 per cent was represented by inspection States, whereas for the same year 85.96 per cent of the employees were in the same group.

Table 68 shows the fatalities at bituminous mines by the same groups of causes as in Tables 4, 5, and 6, which include the anthracite mines. It also shows the actual number killed in each group and the percentage of fatalities due to each class, as well as the number killed per 1,000 men employed.

Figure 8 shows the fatality rates by principal causes from 1891 to 1914. In 1890 the number killed by falls of roof and pillar coal per 1,000 men employed was 1.259. This rate gradually increased until

TABLE No. 67.—PRODUCTION, EMPLOYEES, AND FATALITIES, SHOWING PERCENTAGE OF BITUMINOUS COAL-MINING INDUSTRY FOR WHICH COMPLETE RETURNS ARE AVAILABLE, 1880 TO 1914.

Year.	Total for United States. <sup>a</sup>				Total for States having inspection service, or reporting accidents.								
	Production (short tons).	Number em- ployed.	Days worked.	Average tonnage.		Production.		Number employed.		Number killed.		Production per death.	
				Per man per year.	Per man per day.	Short tons.	Per cent of total.	Number.	Per cent of total.	Total.	Per 1,000 em- ployed.		Per mil- lion tons mined.
1880.	111,302,322	192,204	226	579	2.56	99,723,850	89.60	165,217	85.96	355	2.15	3.56	280,912
1881.	117,491,238	205,803	223	573	2.57	106,989,544	90.75	184,333	89.37	528	2.86	4.94	202,632
1882.	126,856,567	212,893	219	596	2.72	113,236,126	89.26	188,000	88.35	578	3.05	5.06	197,620
1883.	128,885,231	230,365	204	557	2.73	123,618,977	96.31	222,147	96.43	503	2.26	4.07	245,823
1884.	118,820,405	244,602	171	486	2.84	110,218,498	92.76	227,039	92.82	513	2.26	4.05	214,851
1885.	135,118,193	239,962	194	563	2.94	132,104,933	97.77	233,107	97.14	721	3.09	5.46	183,225
1886.	137,610,276	241,171	192	564	2.94	130,776,737	95.01	231,486	94.80	582	2.51	4.45	224,702
1887.	147,617,519	247,817	196	596	3.04	142,120,157	96.28	238,701	96.32	567	3.09	4.99	200,653
1888.	166,593,623	255,717	211	651	3.09	160,351,393	96.25	246,337	96.33	651	2.64	3.69	236,316
1889.	193,323,187	271,027	234	713	3.05	183,575,167	94.96	255,999	94.46	780	3.05	4.25	235,353
1890.	212,316,112	304,375	234	697	2.98	202,797,380	95.52	285,242	94.70	1,078	3.74	5.32	188,123
1901.	225,828,149	340,235	225	703	3.02	223,977,380	98.12	362,076	97.67	1,424	3.16	4.74	211,000
1902.	260,216,844	370,056	230	703	3.06	255,313,471	98.13	385,008	97.61	1,581	3.96	5.84	175,283
1903.	282,749,348	415,777	225	680	3.02	277,457,593	98.13	419,932	97.96	1,598	3.97	5.97	191,068
1904.	278,659,689	437,832	202	637	3.15	266,008,103	95.46	419,932	97.96	1,598	3.97	5.97	191,068
1905.	315,062,785	460,429	213	684	3.24	308,719,393	97.99	419,932	97.96	1,598	3.97	5.97	191,068
1906.	342,874,867	478,425	213	717	3.36	334,673,477	97.61	467,928	97.81	1,581	3.93	4.72	211,885
1907.	394,750,112	513,258	234	769	3.29	392,288,224	99.37	504,690	97.76	2,531	4.99	6.16	151,810
1908.	332,573,944	516,264	193	644	3.34	326,041,103	98.04	504,690	97.76	2,531	4.99	6.16	151,810
1909.	379,744,257	549,751	217	751	3.46	379,736,904	99.99	555,533	99.99	2,975	5.46	5.46	183,006
1910.	417,111,142	555,533	211	731	3.46	417,111,142	100.00	555,533	100.00	2,920	4.00	5.46	187,888
1911.	405,907,059	554,408	211	738	3.50	405,907,059	100.00	554,408	100.00	2,920	4.00	5.46	187,888
1912.	450,104,982	548,632	223	820	3.68	450,104,982	100.00	548,632	100.00	1,818	3.91	4.04	247,582
1913.	478,523,203	571,899	232	837	3.61	478,523,203	100.00	571,899	100.00	2,167	3.79	4.53	220,823
1914.	422,703,970	583,506	207	673	3.25	422,703,970	100.00	583,506	100.00	1,859	3.19	4.40	227,382

<sup>a</sup> Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Bureau of Census.

<sup>c</sup> Bureau of Mines.



TABLE 68.—FATALITIES IN BITUMINOUS COAL MINES OF THE UNITED STATES, BY PRINCIPAL CAUSES, 1890 TO 1911 (FOR INSPECTION STATES ONLY).

Year.	Falls of roof and pillar coal. (1 and 2)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. <sup>a</sup> (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 22)			Grand total.		Number men employed. <sup>b</sup>
	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Percentage killed.	Number killed per 1,000 employed.	Number killed.	Number employed, 1,000 employed.	
1890.	208	58.59	1.259	27	7.60	0.163	6	1.69	0.036	30	8.45	0.182	47	13.24	0.285	21	5.92	0.127	16	4.51	0.097	355	2,149	165,217
1891.	272	51.52	1.476	39	7.39	0.211	124	23.48	0.673	31	5.87	0.168	25	4.73	0.136	17	3.22	0.092	10	3.79	0.108	528	2,864	184,333
1892.	287	46.60	1.419	56	9.77	0.208	158	27.58	0.840	26	4.54	0.138	29	5.06	0.154	25	4.36	0.134	12	2.09	0.064	573	3,046	188,090
1893.	329	65.41	1.481	46	9.15	0.207	39	7.75	0.176	24	4.77	0.108	16	3.18	0.072	32	6.36	0.144	17	3.38	0.076	503	2,664	222,147
1894.	293	57.12	1.290	52	10.14	0.229	29	5.65	0.128	42	8.19	0.185	51	9.94	0.225	27	5.23	0.119	19	3.70	0.084	513	2,260	222,039
1895.	318	44.10	1.364	70	9.71	0.300	193	26.77	0.828	53	7.35	0.227	34	4.72	0.146	31	4.30	0.133	22	3.05	0.095	721	3,093	233,107
1896.	337	57.90	1.456	62	10.65	0.268	86	14.78	0.371	37	6.36	0.160	22	3.78	0.095	23	3.95	0.099	15	2.58	0.065	582	2,514	231,486
1897.	360	63.75	1.508	55	9.70	0.280	47	8.29	0.197	40	7.06	0.168	22	3.88	0.092	22	3.30	0.088	21	3.07	0.088	567	2,375	231,701
1898.	445	57.05	1.738	84	12.90	0.341	35	5.37	0.142	41	6.30	0.167	22	3.38	0.089	21	3.23	0.085	23	3.07	0.134	651	2,643	246,337
1899.	498	46.19	1.728	94	8.72	0.378	103	13.20	0.402	58	7.44	0.274	48	4.45	0.117	28	3.59	0.110	32	4.10	0.125	780	3,047	285,999
1900.	535	50.42	1.595	127	11.97	0.457	282	26.16	0.978	79	7.33	0.217	117	11.03	0.349	44	4.13	0.131	32	3.25	0.121	1,076	3,162	388,242
1901.	611	42.91	1.687	144	10.11	0.398	413	26.00	1.111	99	6.85	0.273	79	5.55	0.218	44	3.09	0.122	34	3.39	0.094	1,424	3,363	406,098
1902.	711	50.50	1.751	151	10.72	0.372	262	18.61	0.645	138	8.50	0.339	50	4.21	0.178	59	4.21	0.131	52	4.37	0.158	1,400	3,353	447,512
1903.	801	50.44	1.709	163	10.29	0.367	271	19.36	0.702	121	7.49	0.264	56	4.00	0.174	36	2.77	0.080	71	4.47	0.158	1,588	3,529	449,962
1904.	826	52.25	1.705	189	11.95	0.404	316	18.90	0.719	111	7.27	0.246	80	5.04	0.185	59	4.21	0.131	52	4.37	0.158	1,588	3,379	467,928
1905.	911	35.95	1.796	236	10.10	0.504	219	13.85	0.488	115	5.29	0.264	132	6.00	0.299	59	2.33	0.116	111	4.38	0.165	1,581	3,994	507,379
1906.	829	46.91	1.643	222	12.56	0.440	220	18.11	0.634	109	6.17	0.216	157	8.89	0.311	53	3.05	0.105	77	4.36	0.152	1,767	3,501	504,699
1907.	975	46.99	1.951	236	11.37	0.472	264	12.72	0.528	122	5.88	0.243	130	7.74	0.317	37	1.78	0.074	73	3.52	0.146	2,075	4,152	499,734
1908.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1909.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1910.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1911.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1912.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1913.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533
1914.	1,051	47.79	1.910	287	12.93	0.516	437	21.49	0.859	113	5.09	0.203	130	5.86	0.253	60	2.70	0.108	86	4.14	0.166	2,220	3,996	555,533

<sup>a</sup> See also figures 5 and 8.<sup>b</sup> See also Table 67.

in 1909 it was 1.951. Since 1909 the rate has been decreasing until in 1914 it was 1.548 per 1,000 men employed. With reference to mine cars and locomotives the fatality rate per 1,000 men employed in 1890 was 0.163. The rate increased quite uniformly to 0.593 per 1,000 employed in 1913. The rate for 1914 was slightly lower. The fatality rates due to gas and dust explosions have been very erratic, reaching the highest point in 1907, when the rate was 1.796 per 1,000 employed. Since the year 1907 this rate has decreased, although irregularly, to 0.523 per 1,000 employed in 1914.

The fatality rate due to explosives gradually increased from 1890, during which year the rate was 0.182 per 1,000 employed, to 1903, when it reached its highest point, 0.339 per 1,000. Since the introduction of permissible explosives and more strict rules concerning the handling and use of explosives, together with more efficient mine-inspection service, the fatality rate has gradually decreased until in 1914 the number killed per 1,000 employed was 0.096. This reduction is illustrated in figures 5 and 8.

The number of accidents at shafts has decreased slightly, whereas the number of those on the surface shows a gradual increase.

The percentage of coal mined by machines since 1891, when the first records are available, is shown in figure 10. In 1891 only 5.26 per cent of the bituminous coal was mined by machines. The quantity has steadily increased year by year until in 1914, 51.7 per cent of the coal was reported as machine mined. The upper curve in figure 10 includes all hand-mined coal as well as that shot off the solid as distinguished from the machine product. Details of accidents as related to machine mining follow.

### MACHINE MINING.

A study of coal-mine accidents would not be complete without some reference to machine mining. It would be very desirable, indeed, if it were possible to tabulate data for a period of years, showing the actual number of men employed in machine-worked mines, together with the corresponding casualties occurring therein. Data of this character are not available, however, and hence it is impossible to make such a study. The United States Geological Survey, however, has for a number of years, 1896-1913, collected and published data showing the percentage of coal mined by machines in each State, and this information is used as a basis for the study of mine accidents as tabulated herein.

In comparing figures of production, number of men employed, fatalities, etc., for the 18-year period, those States have been included in which complete accident-fatality records and the number of employees are available. Inasmuch as details are lacking to show the number of mines where mining machines are used, the only other alternative whereby comparative results may be obtained is to group the States according to the percentage of coal mined by

TABLE 69.—NUMBER OF MACHINES USED IN THE VARIOUS COAL-MINING STATES. <sup>a</sup>

State.	Number of machines used in the year—																
	1891	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1914
Alabama.....	.....	.....	45	37	440	430	464	508	553	643	882	1,048	1,080	1,217	1,260	1,361	1,812
Arkansas.....	.....	.....	15	21	233	254	256	289	329	403	506	471	513	507	631	645	1,751
California.....	.....	14	.....	.....	.....	20	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado.....	20	34	37	43	63	90	62	98	157	125	121	141	175	211	253	256	306
Georgia.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....	.....	.....	.....	.....
Idaho.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Illinois.....	241	307	320	392	440	430	464	508	553	643	882	1,048	1,080	1,217	1,260	1,361	1,812
Indiana.....	47	186	174	233	247	254	256	289	329	403	506	471	513	507	631	645	1,751
Iowa.....	9	45	49	56	41	40	53	31	10	39	32	34	6	28	5	17	46
Kansas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kentucky.....	.....	.....	162	158	189	239	237	318	308	453	527	600	708	759	877	899	1,383
Maryland.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Michigan.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Minnesota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Missouri.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montana.....	62	62	61	62	75	81	70	65	63	57	58	76	86	57	81	99	98
New Mexico.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
North Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ohio.....	114	209	224	245	278	341	376	559	724	865	1,041	1,255	1,328	1,343	1,433	1,452	1,669
Oklahoma.....	.....	56	54	75	74	58	47	23	36	18	29	29	11	17	34	13	116
Pennsylvania (bituminous).....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tennessee.....	72	454	690	1,085	1,343	1,786	2,058	2,620	3,310	3,645	4,254	4,515	4,940	5,103	5,616	5,719	6,326
Texas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Utah.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virginia.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia.....	8	25	47	86	154	327	403	579	788	901	1,105	1,322	1,533	1,574	1,844	1,966	2,607
Wyoming.....	34	39	45	48	56	69	74	69	59	72	81	83	79	88	127	98	198
<b>Total.....</b>	<b>545</b>	<b>1,440</b>	<b>1,950</b>	<b>2,622</b>	<b>3,125</b>	<b>3,907</b>	<b>4,341</b>	<b>5,418</b>	<b>6,688</b>	<b>7,663</b>	<b>9,184</b>	<b>10,212</b>	<b>11,144</b>	<b>11,569</b>	<b>13,049</b>	<b>13,254</b>	<b>16,507</b>
Coal mined per machine (tons).....	11,398	11,373	11,579	12,362	14,068	13,510	13,325	12,848	11,712	10,258	11,258	11,638	12,381	10,648	10,920	13,127	13,231

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.



machines. Four groups have therefore been used as follows: Group I includes those States in which less than 20 per cent of the coal produced was mined by machines, leaving the other 80 per cent of the coal as mined by hand or shot off the solid. Group II includes those States in which 20 to 39 per cent of the coal produced was mined by machines. Group III includes those States in which 40 to 59 per cent of the coal produced was mined by machines. Group IV includes those States in which 60 per cent or more was produced by mining machines.

TABLE 70.—NUMBER AND TYPE OF COAL-CUTTING MACHINES IN OPERATION IN THE UNITED STATES, 1899 TO 1914, INCLUSIVE.<sup>a</sup>

Year.	Number of machines in use.					
	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.
1899.....	1,997	1,106	22			3,125
1900.....	2,350	1,509	48			3,907
1901.....	2,580	1,716	45			4,341
1902.....	3,185	2,182	51			5,418
1903.....	3,887	2,717	54			6,658
1904.....	4,483	3,102	78			7,663
1905.....	5,525	3,557	102			9,184
1906.....	5,911	4,144	157			10,212
1907.....	6,227	4,652	285			11,164
1908.....	6,380	4,992	197			11,569
1909.....	7,107	5,590	352			13,049
1910.....	6,716	5,973	518			13,207
1911.....	6,535	5,943	481	777		13,736
1912.....	6,833	6,425	545	1,371	124	15,298
1913.....	6,327	6,036	791	2,208	117	16,379
1914.....	5,878	6,859	618	3,024	128	16,507

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

GROUPING OF STATES, ACCORDING TO PERCENTAGE OF COAL MINED BY MACHINES, FOR THE PERIOD 1896-1913, AND NUMBER OF YEARS EACH STATE IS REPRESENTED IN EACH GROUP.

[Group I, less than 20 per cent mined by machine; Group II, 20 to 39 per cent; Group III, 40 to 59 per cent; Group IV, 60 per cent or more.]

Coal-mining States.	Group.			
	I	II	III	IV
	Years.	Years.	Years.	Years.
Alabama.....	16	2		
Arkansas.....	14			
California.....	5			
Colorado.....	16	2		
Georgia.....	4			
Illinois.....	6	9	3	
Indiana.....		12	6	
Iowa.....	18			
Kansas.....	18			
Kentucky.....	1	4	8	5
Maryland.....	18			
Michigan.....	3	8	3	1
Missouri.....	15	3		
Montana.....		7	8	1
New Mexico.....	17	1		
North Carolina.....	2			
North Dakota.....		4	2	
Ohio.....		3	6	9
Oklahoma.....	18			
Oregon.....	4			
Pennsylvania (bituminous).....	2	7	9	
Tennessee.....	17	1		
Texas.....	4			
Utah.....	18			
Virginia.....	3	3	2	
Washington.....	18			
West Virginia.....	5	8	5	
Wyoming.....	5	5	1	



The fatalities during this period have been divided into two classes, namely, common and exceptional. Common accidents are those of daily occurrence in which less than 5 men are killed at one time. Exceptional accidents are defined as those including mine disasters in which 5 or more men are killed at one time.

#### PRODUCTION.

Table 73 shows the production of coal for Group I from 1896 to 1913. The production of this group, 113,995,776 tons in 1896, has gradually declined until in 1913 it was only 39,509,308 tons. Group II (Table 76) produced in 1896, 16,780,981 tons and reached its highest point in 1902. In 1913 the production of this group was 41,373,914 tons. A number of States, in Group II, passed from this group into Group III (Table 79) in 1904, so that Group III, while not producing any coal in 1896, produced 340,591,068 tons in 1913. Group IV (Table 82), in which more than 60 per cent was mined by machines, does not make its appearance until 1900. It then dropped out for four years and appeared again in 1905 with 25,552,950 tons. In 1913 this group produced 57,048,913 tons.

#### NUMBER OF MEN EMPLOYED.

Tables 73, 76, 79, and 82 show the number of men employed in each group for the period covered (fig. 9). The number employed in Group I, 197,180 men in 1896, has gradually declined until in 1913 there were 67,714 employed in this class of mines. Group II began in 1896 with only 34,306 men and gradually increased to 207,976 men in 1904. At the close of 1904 a large percentage of this group passed into Group III, so that although Group III does not show any employees in 1896 there were 366,880 employees in 1913. The number of men in Group IV varies from none in 1904 to 75,452 in 1913.

#### EFFECT OF MACHINE MINING ON FATALITY RATES.

Table 69 shows by States and years the number of mining machines in use from 1891 to 1914. During this period the number of machines has increased from 545 to about 17,000, and the production per year per machine has increased from 11,398 tons in 1891 to 14,802 tons in 1913. Table 70 shows the number of each of five different types of machines in use since 1899.

As there has been an enormous increase in the use of mining machines, Tables 69 to 85 have been compiled for the purpose of analyzing accidents as related to this method of mining. When mining machines were first introduced, there were many who felt that they added another serious hazard to the coal-mining industry.



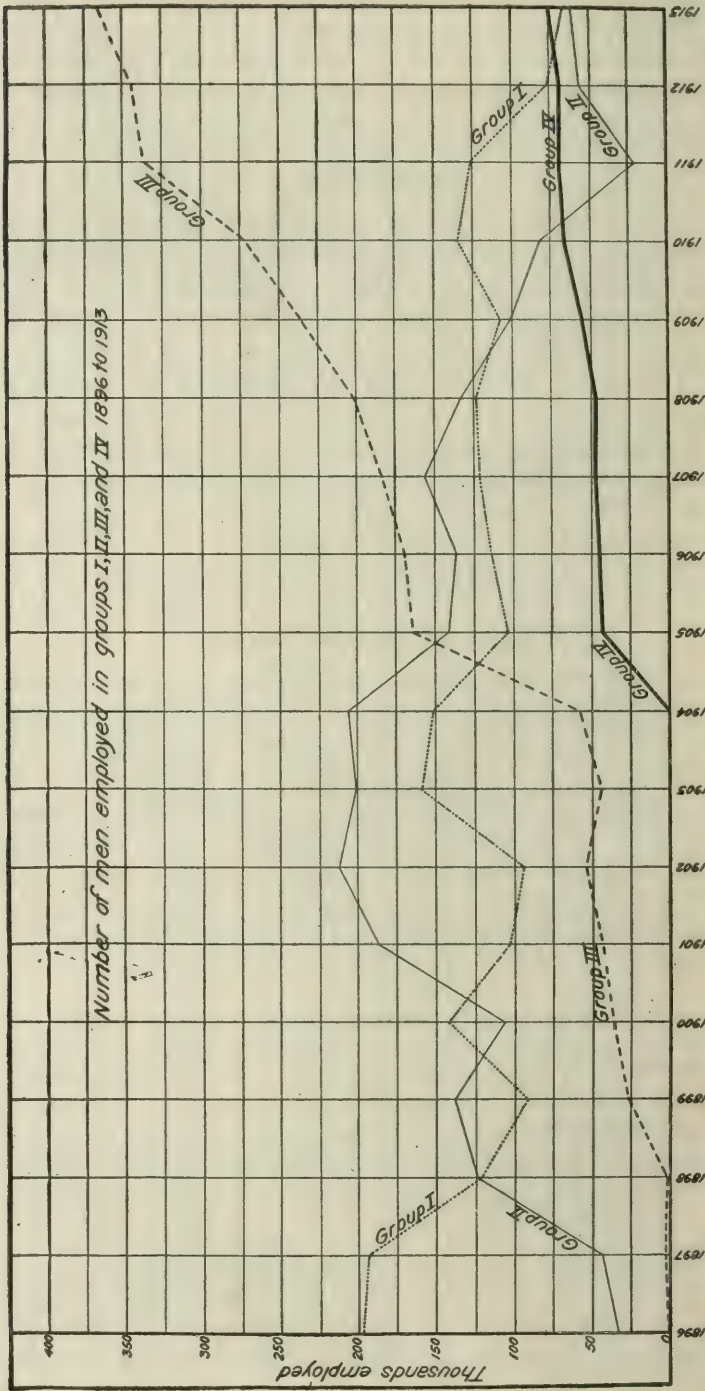


FIGURE 9.—Number of men employed in bituminous coal mines of the United States, by groups, based on percentage of coal mined by machines, 1896-1913. (Based on Tables 73, 76, 79, and 82.)

Although their use may have increased the number of accidents due to machinery and electricity, yet the results shown in Tables 69 to 85 and figures 10 to 15 do not seem to bear out the first impression. The increase of accidents due to machinery and electricity seems to be more than offset by the decrease in fatalities due to explosives, as shown in Table 5.

As indicated, the fatality rate, in those groups where the percentage of machine mining is largest, is lower than in those groups where the amount of coal undercut by hand or shot from the solid is the largest.

As indicated in Table 71 and figure 10, the first three groups are practically of the same rank, each employing slightly over 2,000,000 men during the 18-year period. Group IV is much smaller, employing only 522,293 men. The total production for the first three groups is nearly the same, so that comparisons for those groups may be made on an equal basis. The total number of men killed in exceptional accidents, in all of the groups, was 5,183, and in common accidents, 21,475. In Group I the number of fatalities due to exceptional accidents was 2,476, representing a rate of 1.11 per 1,000 employed. The exceptional-accident rates per 1,000 men employed are 0.76 for Group II, 0.38 for Group III, and 0.20 for Group IV. The rates for common accidents are 2.98 for Group I, 2.81 for Group II, 2.92 for Group III, and 2.62 for Group IV. There is a gradual decline in the total-fatality rate, ranging from 4.09 per 1,000 employed, in Group I, to 2.82 in Group IV. The number of fatalities per million tons mined in Group I is 6.89 for the entire period, and in Group III, which has the lowest rate, is 4.00, for Group IV it is 4.16.

In Table 72 (figure 11), the four groups are compared by principal causes of accidents, showing the percentage of fatalities and the number killed per 1,000 men for each group.

#### CAUSES OF ACCIDENTS.

The fatalities due to falls of roof (figure 11) are practically the same for each of the four groups, ranging from 1.70 in Group I per 1,000 men employed to 1.79 in Group III. The percentage of fatalities due to falls of roof is lowest in Group I, ranging from 41.66 in Group I to 60.90 in Group IV. The comparison on a percentage basis is not however as true as that based on the actual number of men employed. A sudden increase or decrease in one particular class of accidents affects the total, and percentages derived from this base will be more or less altered. When comparisons are made on the basis of actual number of employees, a large disaster due to one cause will not alter the comparisons for the other causes as the rates are derived from a base that remains unchanged.

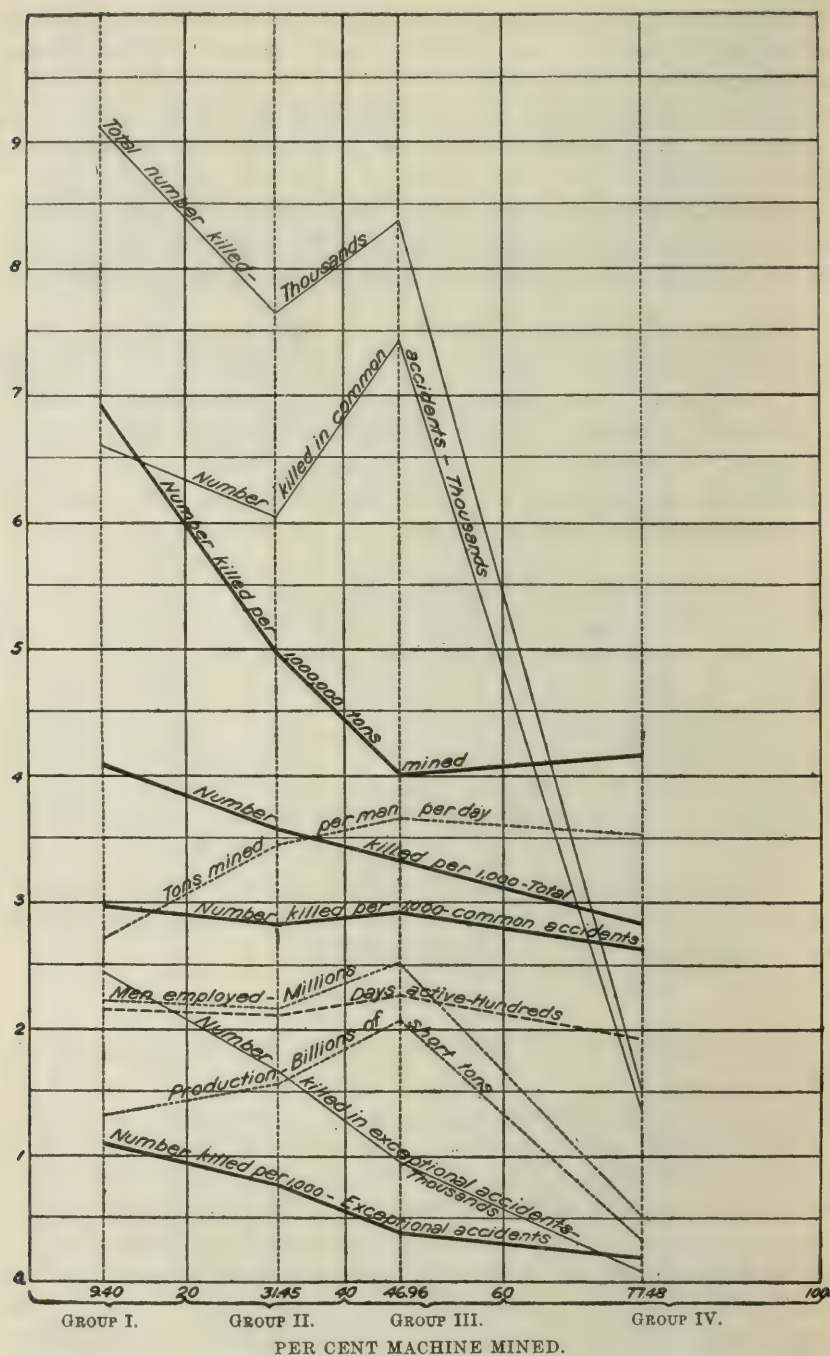


FIGURE 10.—Total number killed, fatality rates, men employed, tons produced, and days active at the bituminous coal mines of the United States, by groups based on the percentage of coal mined by machines, 1896-1913. (Based on Table 71.)



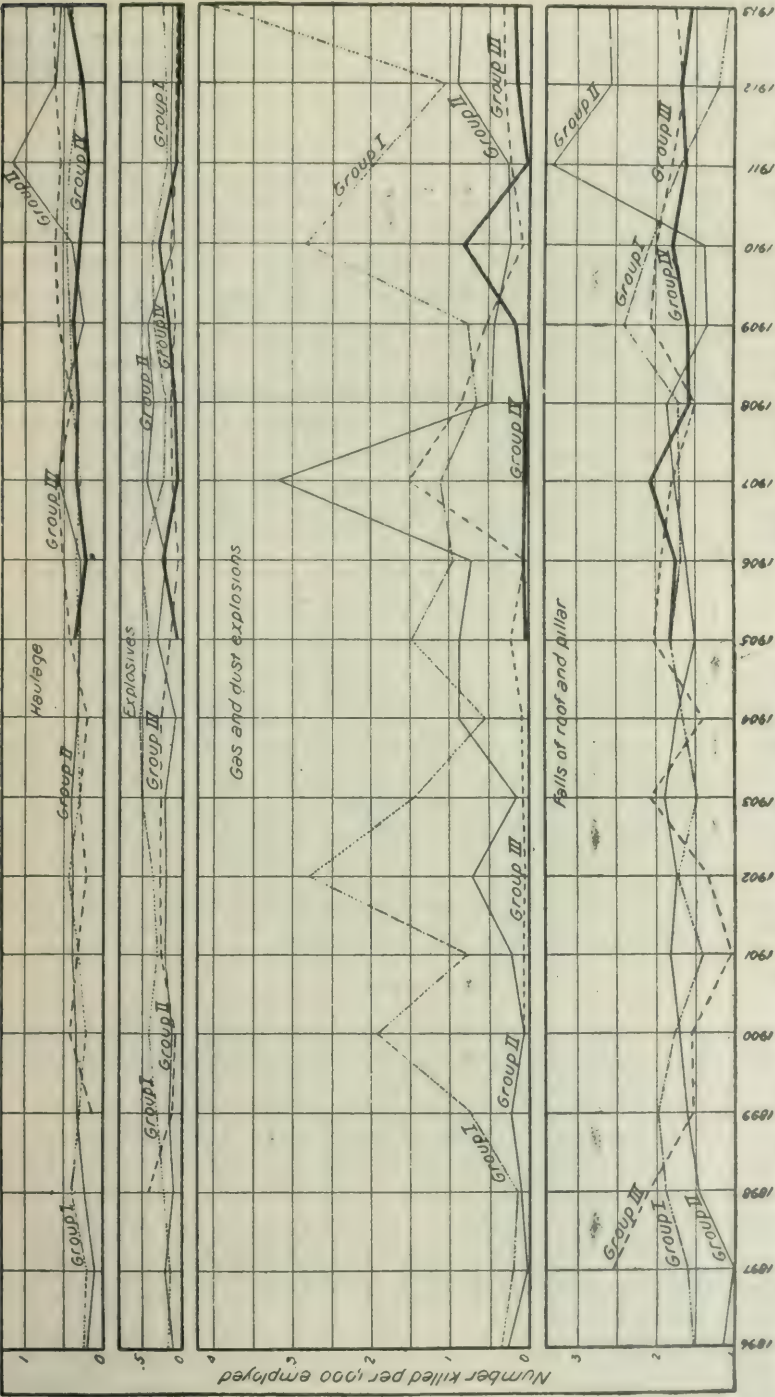


FIGURE 11.—Number of men killed per 1,000 employed in bituminous coal mines of the United States, by principal causes, by groups based on percentage of coal mined by machines, 1896-1913. (Based on Tables 74, 77, 80, and 83.)

There is but little difference in the fatality rate by reason of accidents due to mine cars and locomotives (fig. 11). In Groups I and IV the rates are practically the same, being 0.35 and 0.34 respectively, but in Groups II and III the rates are slightly higher.

#### GAS AND DUST EXPLOSIONS.

The most striking difference in the number of fatalities in the various groups is in accidents due to gas and dust explosions. It will be noted that 29.40 per cent of all of the fatalities in Group I were due to gas and dust explosions, and that the percentage due to this cause declines as the percentage of machine-mined coals, only 6.92 per cent of the total fatalities in Group IV being due to this cause. As stated above, the percentage comparison is not as fair as that based on the number of men employed. The fatality rate in Group I due to gas and dust explosions was 1.20 per 1,000 men employed during the 18-year period, in Group II the rate was 0.66, in Group III, 0.39, and in Group IV, 0.19 per 1,000 employed. These differences are shown in figure 11.

#### EXPLOSIVES.

As would be expected, the fatality rate due to explosives (fig. 11) is higher in Group I than in the other groups. In Group I the maximum amount of explosives is used and much of the coal mined is shot off the solid; its fatality rate is 0.33 per 1,000 men employed. In Groups II, III, and IV, where less explosives are used, the fatality rates are 0.23, 0.12, and 0.15 per 1,000 employed, respectively. In the latter two groups there is a minimum amount of explosives used in the coal mines.

With reference to miscellaneous underground, shaft, and surface accidents there is no variation of importance.

#### MINING CONDITIONS.

These figures are not absolute proof that lower fatality rates in Group IV as compared with Group I are due to the larger use of machines in the mines of Group IV. Many small mines are included in Group I in which hand mining prevails. The small mines do not always have the most improved equipment, and many times less attention is given to safety measures. The mines in Group I use a maximum amount of explosives, are operated under all classes of roof conditions, and include all types of coal beds ranging from thick to thin with various degrees of inclination, from horizontal to vertical.

The hand-mining mines are in most cases operated more hours a day and, as shown in Table 71, more days a year as compared with Group IV. The number of days active is 218 for Group I, 212 for Group II, 227 for Group III, and 192 for Group IV. With the excep-

tion of Kentucky, the employees in Group IV are all on an 8-hour basis. The other groups contain many 9 and 10 hour men.

As regards the mines in which the major part of the coal is mined by machine, they include but few small mines and hence have more systematic management. When a mine has reached the stage where the management is financially able to install machines, it is usually conducted on a more business-like basis than are the small and poorly financed properties, has better haulage systems, and more efficient ventilation. In machine mining a minimum amount of explosives is used and in a mine where machines are introduced it is essential that good roof conditions prevail and that the coal bed is of reasonably uniform thickness. Also machines are operated in the flatter lying beds and are seldom used in the steeply inclined measures. The majority of the States in which the largest percentage of coal is mined by machines are operated on an 8-hour basis and less days per year, hence the time of exposure to the dangers of mining is less.

#### FATALITY RATES ON BASIS OF COAL MINED BY MACHINE.

The total fatality rate at the four groups of mines, based on the percentage of machine-mined coal, from 1896 to 1913, is shown in figure 12. The upper part of the figure represents, as indicated, the total fatality rate at bituminous coal mines during this period. The second or middle part of the figure shows the fatality rate due to "common" accidents, that is, those in which less than 5 men are killed at one time. These rates are reasonably close together, Group IV showing the lowest and Group I, as a whole, the highest rate. The lower part of the figure shows the fatality rate due to "exceptional" accidents. Here again Group I is high, and is followed closely by Group II; Group IV is exceedingly low.

The amount of coal mined per day per man in the various groups of mines is given in figure 13. The curves show that in Group I, in which less than 20 per cent of the coal was mined by machine, the average number of tons mined per day is 2.72 (Table 73), while in Group III it ranges from 2.80 to about 3.90 tons per day. Group II is more erratic, and since 1910 many of the mines originally in this group have passed into Group III, so that since that year there has been a decrease in the amount of coal produced per man per day. Group IV remains practically stationary, with an average of 3.53 tons per day.

Figure 13 also shows the fatalities per million tons mined according to the four groups outlined above. In Group I the fatality rate is exceedingly high when based on the number of tons mined per fatality. This rate varies from 4.06 to 10.68, the average being 6.89 (Table 73). As would be expected, the number of fatalities per million tons produced in Groups III and IV are considerably lower than in the other two groups, the average being, respectively, 4.00 and 4.16.



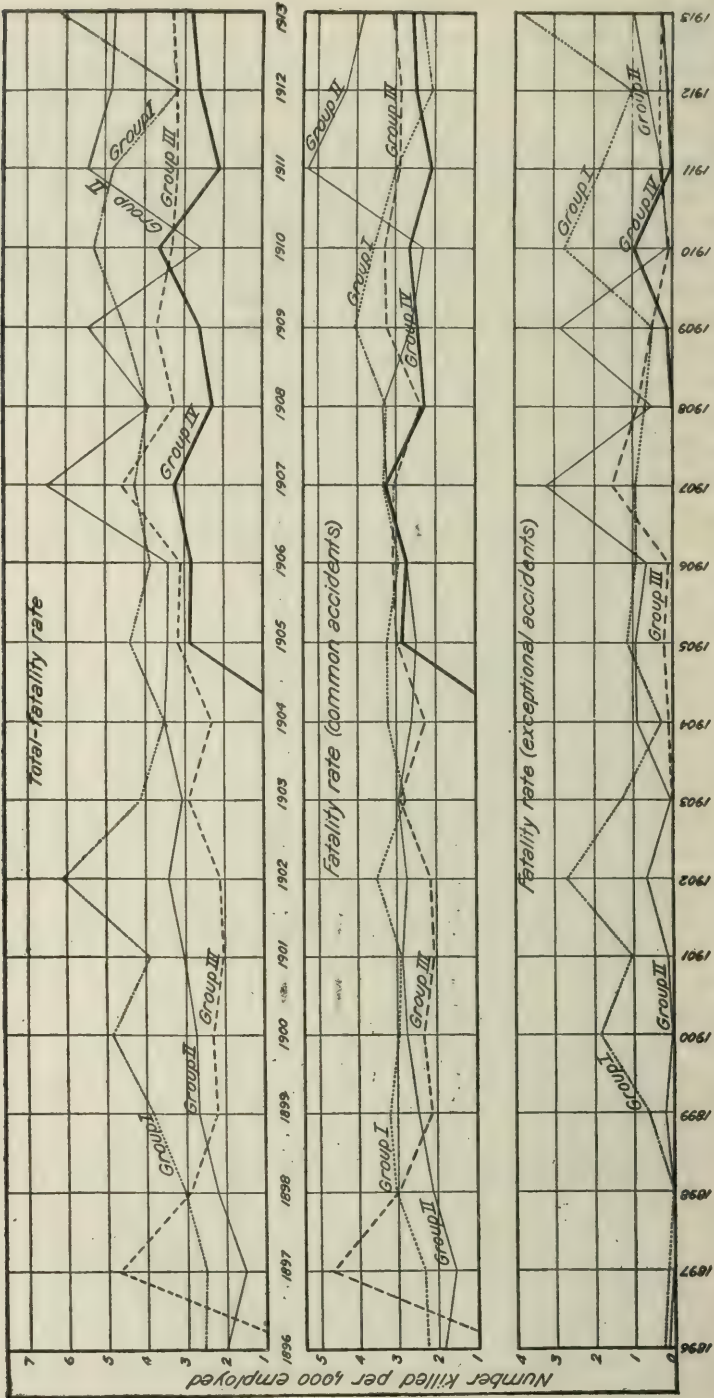


FIGURE 12.—The total number killed per 1,000 employed in bituminous coal mines of the United States; also number killed per 1,000 employed in common and in exceptional accidents, by groups based on percentage of coal mined by machine, 1896-1913. (Based on Tables 73, 76, 79, and 82.)

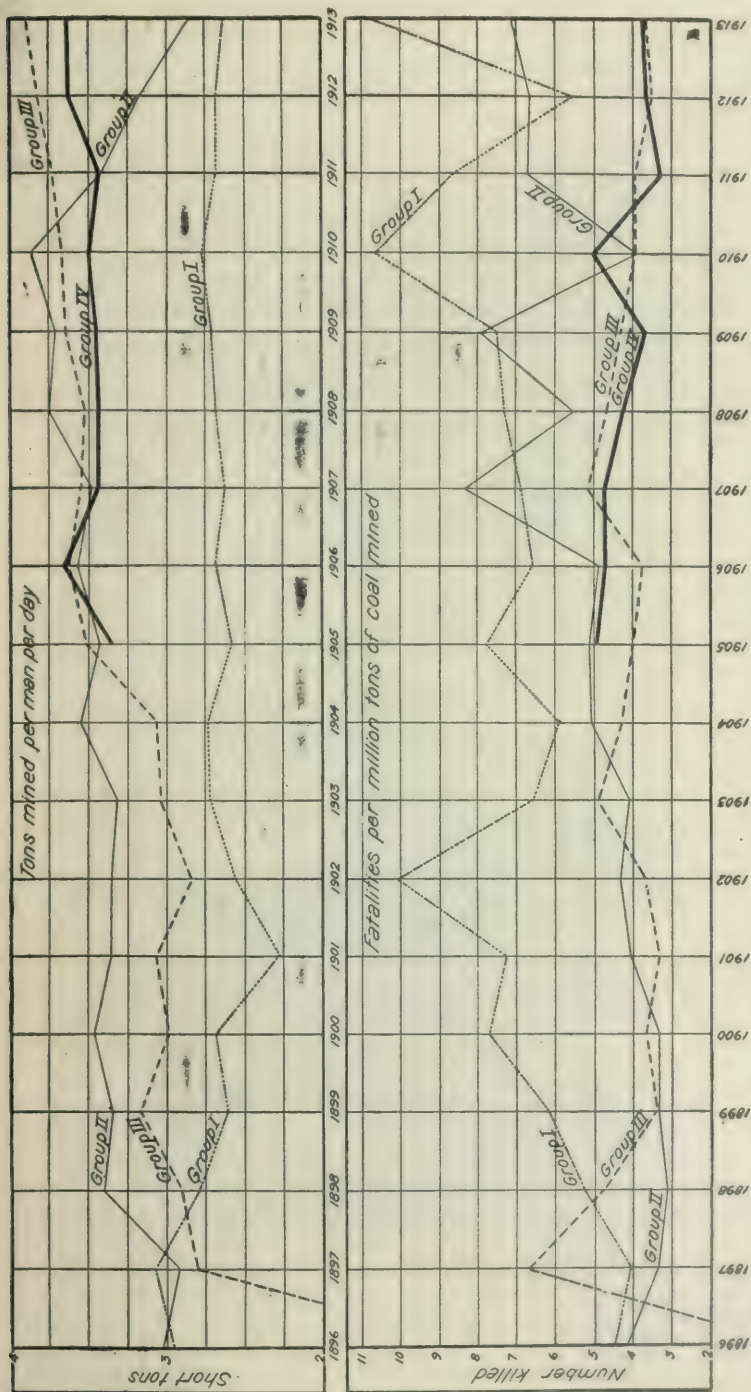


FIGURE 13.—Tons mined per man per day and number of men killed per 1,000,000 tons mined in the bituminous coal mines of the United States, by groups based on the percentage of coal mined by machine, 1896-1913. (Based on Tables 73, 76, 79, and 82.)





TABLE 7A.—PERCENTAGE OF FATALITIES AND RATE PER 1,000 MEN EMPLOYED, BY PRINCIPAL CAUSES AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH LESS THAN 20 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP I.

(See fig. 11.)

Year.	Falls of roof and pillar coal. (1 and 2)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 22)			Grand total.	
	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.
1886.....	297	58.01	1.51	54	10.55	0.27	76	14.84	0.38	33	6.45	0.17	21	4.10	0.11	17	3.32	0.09	14	2.73	0.07	512	2.60
1887.....	310	63.39	1.60	44	8.60	0.23	45	9.20	0.23	31	6.34	0.16	21	4.29	0.11	19	3.89	0.10	19	3.68	0.10	489	2.53
1888.....	228	51.62	1.39	49	13.94	0.23	33	6.22	0.19	26	7.03	0.21	9	2.43	0.07	14	3.78	0.12	21	4.58	0.17	370	3.06
1889.....	182	51.70	1.29	31	8.81	0.11	69	19.63	0.32	29	8.24	0.22	14	3.98	0.15	11	3.12	0.12	16	4.55	0.18	352	3.85
1890.....	253	56.67	1.49	36	8.92	0.25	273	39.56	1.92	50	8.55	0.41	34	4.93	0.24	17	2.46	0.12	18	2.61	0.06	690	4.85
1901.....	143	33.89	1.73	43	8.42	0.36	281	20.05	1.70	32	7.92	0.31	87	21.33	0.84	19	4.70	0.18	6	1.49	0.06	404	3.91
1902.....	202	29.38	1.45	43	7.42	0.31	261	45.08	2.77	37	6.39	0.39	52	8.98	0.55	10	1.73	0.11	11	1.90	0.12	579	6.15
1903.....	207	32.02	1.45	43	7.15	0.36	229	34.80	1.43	82	12.46	0.51	19	2.89	0.12	17	2.58	0.11	25	3.80	0.16	658	4.12
1904.....	259	47.18	1.63	34	10.17	0.22	154	33.48	1.33	85	15.98	0.56	19	3.57	0.12	30	5.64	0.20	13	2.44	0.09	532	3.51
1905.....	194	43.30	1.60	33	7.17	0.22	180	15.04	1.47	46	10.00	0.44	20	4.35	0.13	11	1.52	0.07	11	2.39	0.10	460	4.40
1906.....	194	43.30	1.60	38	7.34	0.31	107	23.88	1.03	62	13.84	0.54	15	3.35	0.13	10	2.46	0.08	18	4.02	0.16	448	3.90
1907.....	208	40.15	1.72	41	9.15	0.36	137	26.45	1.07	34	6.56	0.28	75	14.48	0.75	11	1.93	0.08	16	3.06	0.13	518	4.27
1908.....	210	43.30	1.72	42	10.72	0.42	82	16.91	1.07	24	5.37	0.38	92	18.97	0.91	11	2.07	0.09	9	1.85	0.07	485	3.94
1909.....	263	53.67	2.43	57	9.59	0.43	82	16.74	0.76	41	8.98	0.33	34	6.94	0.31	15	2.62	0.05	18	3.67	0.17	490	4.53
1910.....	281	52.67	2.09	65	7.61	0.43	381	44.61	2.83	52	6.06	0.39	42	4.92	0.41	14	1.64	0.10	19	2.23	0.14	854	6.34
1911.....	218	35.73	1.73	60	9.84	0.47	243	39.84	1.92	26	4.26	0.21	33	5.41	0.26	10	1.64	0.08	20	3.28	0.16	610	4.83
1912.....	93	28.27	1.22	25	10.29	0.33	81	33.33	1.06	17	7.00	0.22	17	7.00	0.22	4	1.64	0.07	6	2.13	0.08	243	3.18
1913.....	74	17.54	1.09	28	6.64	0.41	276	65.40	4.08	18	4.27	0.27	12	2.84	0.18	5	1.18	0.07	9	2.43	0.13	422	6.23
Total.....	3,798	41.66	1.70	783	8.59	0.35	2,680	29.40	1.20	739	8.11	0.33	616	6.76	0.28	231	2.53	0.11	269	2.95	0.12	9,116	4.09

TABLE 75.—FATALITIES, BY CAUSES, AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH LESS THAN 20 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP I.

Year.	Killed underground.											Killed in shaft.						Killed on surface.						Grand total.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.		Total.	
1896.	247	50	54	11	65	33	3	2	2	1	8	15	481	8	1	8	17	17	3	1	1	3	14	512		
1897.	249	61	44	14	38	31	2	1	2	1	8	15	481	10	2	6	19	19	2	2	2	7	19	489		
1898.	197	31	49	13	8	26	2	1	1	1	8	8	335	7	1	7	14	14	5	4	4	1	21	370		
1899.	152	30	31	36	205	59	3	1	1	1	1	1	325	6	3	7	11	11	5	1	1	3	16	352		
1900.	223	30	36	98	33	29	3	2	2	2	21	21	355	5	3	10	17	17	1	1	1	2	18	690		
1901.	120	25	34	36	245	32	3	1	1	1	16	36	379	3	3	10	19	19	1	1	2	4	16	404		
1902.	147	18	43	22	49	37	1	1	1	1	3	14	366	5	2	4	10	10	4	3	2	1	11	579		
1903.	213	24	49	224	5	82	5	3	1	1	12	13	469	10	3	14	30	17	10	2	2	2	11	658		
1904.	219	32	54	29	51	46	2	2	1	1	13	15	489	13	3	1	7	7	4	1	1	1	13	532		
1905.	172	16	33	37	117	62	1	6	1	1	10	57	419	6	2	2	11	10	7	1	1	3	11	460		
1906.	177	17	41	99	8	62	1	8	1	1	10	57	419	7	2	2	11	10	7	1	1	3	11	448		
1907.	188	20	38	37	100	34	1	8	1	1	29	41	482	4	1	3	11	10	7	1	1	3	16	518		
1908.	188	22	52	18	64	29	1	15	3	1	29	41	485	5	1	5	11	10	7	1	1	3	16	485		
1909.	228	35	47	56	26	41	4	12	1	1	15	15	487	1	1	3	14	14	9	2	2	4	18	490		
1910.	241	40	65	79	302	52	5	12	1	1	10	19	821	9	2	2	15	15	9	3	3	1	19	854		
1911.	197	21	60	10	293	26	5	16	1	1	8	8	580	4	4	4	10	10	6	1	2	1	20	610		
1912.	171	22	25	76	5	17	2	10	1	1	11	8	233	2	1	3	4	4	1	1	1	6	6	243		
1913.	71	3	28	8	298	18	2	3	1	1	1	5	408	2	1	3	5	5	1	1	1	1	9	422		
Total.	3,301	497	783	865	1,815	739	27	104	12	4	135	334	8,616	108	24	85	231	231	91	2	34	25	42	75	209	9,116

TABLE 76.—PRODUCTION, MEN EMPLOYED, AND NUMBER KILLED IN AND ABOUT THE BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 20 TO 39 PER CENT OF THE COAL WAS MINED BY MACHINES, 1886 TO 1913, INCLUSIVE, GROUP II.

(See figs. 9, 12, and 13.)

Totals for States in Group II having accident statistics.																
Year.	Grand totals, Group II.			Tons mined per man.	Production (short tons).	Per-centage mined by machine.	Men em- ployed.	Days active.	Number killed.			Number killed per 1,000 employed.			Tons mined per man.	
	Production (short tons).	Men em- ployed.	Tons mined per man.						Total.	In excep- tional acci- dents.	In com- mon acci- dents.	Total.	In excep- tional acci- dents.	In com- mon acci- dents.	Number killed per million tons mined.	Per year.
1886	18,324,426	36,641	500	16,780,981	25.82	34,336	161	70	7	63	2.01	0.20	1.81	4.17	489	3.04
1887	21,153,612	48,930	434	19,563,208	30.91	43,279	158	67	...	67	1.55	...	1.55	3.36	461	2.92
1888	88,490,651	123,182	718	88,095,651	27.67	123,182	211	274	29	266	2.22	.06	2.16	3.10	718	3.40
1889	112,438,286	140,661	799	110,233,680	28.74	138,491	258	372	8	315	2.69	.21	2.48	3.37	799	3.31
1890	87,305,770	106,442	820	87,175,887	33.07	106,116	257	269	...	263	2.76	...	2.76	3.36	822	3.47
1901	140,790,735	187,967	749	140,624,125	29.89	187,087	223	365	29	236	3.01	.15	2.86	4.02	719	3.36
1902	166,722,213	213,711	780	166,495,078	30.35	213,312	322	368	110	188	3.41	.08	3.33	4.17	780	3.36
1903	169,787,113	213,190	796	169,787,113	34.17	212,150	225	361	117	404	3.41	.08	3.33	4.17	796	3.32
1904	149,067,343	213,636	698	148,888,967	34.12	212,150	196	378	133	312	3.42	.07	3.35	4.18	692	3.35
1905	49,313,369	142,664	342	48,308,967	32.40	141,889	190	473	92	369	3.43	.07	3.36	4.17	342	3.35
1906	101,619,053	141,111	723	101,308,952	32.88	137,259	223	473	123	339	3.43	.07	3.36	4.17	723	3.35
1907	147,882,546	136,128	798	147,463,184	35.30	139,690	223	1,013	512	346	3.45	.31	3.14	4.17	798	3.38
1908	70,367,323	130,644	538	70,367,323	37.30	131,290	157	513	68	465	3.46	.21	3.25	4.17	538	3.40
1909	58,269,317	82,746	681	58,269,317	37.64	109,820	188	556	293	993	3.51	2.60	2.91	7.88	681	3.79
1910	47,688,517	20,849	820	47,688,517	37.75	87,746	171	232	14	198	2.53	.17	2.36	3.83	820	3.87
1911	44,431,879	57,115	797	44,431,879	34.33	26,849	240	115	36	119	5.23	.24	4.98	6.73	820	3.42
1912	41,377,944	51,833	669	41,377,944	25.27	57,415	232	241	5	245	4.59	.62	3.97	6.63	797	3.18
1913	41,377,944	51,833	669	41,377,944	24.69	61,823	234	297	61	246	4.89	.93	3.96	7.18	669	2.86
Total	1,584,880,534	2,180,510	727	1,559,863,477	31.45	2,146,968	212	7,675	1,633	6,042	3.57	.76	2.81	4.02	726	3.42



TABLE 77.—PERCENTAGE OF FATALITIES AND RATE PER 1,000 MEN EMPLOYED, BY PRINCIPAL CAUSES AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 20 TO 39 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP II.

(See fig. 11.)

Year.	Falls of roof and pillar coal. (1 and 2)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 22)			Grand total.	
	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.
1886.....	40	57.14	1.17	8	11.43	0.23	10	14.29	0.29	4	5.71	0.12	1	1.43	0.03	6	8.57	0.17	1	1.43	0.03	70	2.04
1887.....	44	65.67	1.01	6	8.95	.14	2	2.99	.05	9	13.43	.21	1	1.49	.02	3	4.48	.07	2	2.99	.05	67	1.55
1888.....	182	66.42	1.48	35	12.77	.28	12	4.38	.10	14	5.11	.11	12	4.38	.10	7	4.48	.05	12	4.38	.10	274	2.22
1889.....	223	59.94	1.61	49	13.17	.36	34	9.14	.25	25	6.72	.18	15	4.03	.10	13	3.50	.09	13	3.50	.09	372	2.69
1890.....	183	62.46	1.72	41	13.99	.39	6	2.05	.06	14	4.78	.13	14	4.78	.13	21	7.16	.20	14	4.78	.13	293	2.76
1901.....	343	60.71	1.83	78	13.80	.41	39	6.90	.21	24	6.90	.21	24	4.25	.13	21	3.72	.11	21	3.72	.11	565	3.01
1902.....	373	51.24	1.75	88	14.17	.44	149	20.46	.70	46	7.24	.22	20	2.75	.09	33	4.53	.15	20	2.75	.09	728	3.41
1903.....	383	61.68	1.90	88	14.17	.44	29	4.67	.14	45	7.24	.22	27	4.35	.13	17	2.74	.08	32	5.15	.16	621	3.07
1904.....	365	49.93	1.76	76	10.40	.37	186	25.44	.89	20	2.74	.10	28	3.83	.13	24	3.23	.12	32	5.15	.16	731	3.52
1905.....	229	42.83	1.48	47	9.63	.33	125	25.61	.88	44	9.02	.31	25	5.12	.18	18	3.69	.13	20	4.10	.14	488	3.45
1906.....	224	47.26	1.62	44	9.28	.32	98	20.67	.71	29	6.12	.21	11	2.32	.08	37	7.81	.27	31	6.54	.23	474	3.44
1907.....	277	27.21	1.77	91	8.94	.58	495	48.63	3.17	72	7.07	.46	30	1.96	.13	19	1.87	.14	36	4.02	.28	1,018	6.51
1908.....	246	47.95	1.85	68	13.25	.51	63	12.28	.48	51	9.04	.38	30	5.85	.23	19	3.70	.14	44	4.32	.27	1,513	3.86
1909.....	138	24.82	1.37	37	4.86	.27	45	8.09	.44	44	7.91	.41	14	6.60	.17	13	1.93	.15	12	2.16	.12	556	5.51
1910.....	116	54.72	1.38	34	16.04	.41	18	8.49	.21	9	4.25	.11	14	2.61	.15	8	6.13	.11	8	3.77	.10	212	2.53
1911.....	69	60.00	3.31	24	20.87	1.15	6	5.22	.29	4	3.48	.19	3	2.61	.08	9	7.62	.14	9	6.13	.11	115	5.52
1912.....	147	52.31	2.56	37	13.17	.64	53	18.86	.92	8	2.85	.14	22	7.83	.38	8	2.85	.14	7	2.83	.13	281	4.89
1913.....	161	54.21	2.60	34	11.45	.55	53	17.84	.86	9	3.03	.14	32	10.77	.52	1	.34	.02	7	2.35	.11	297	4.80
Total.....	3,723	48.51	1.73	874	11.39	.41	1,423	18.54	.66	466	6.33	.23	578	7.53	.27	271	3.53	.12	320	4.17	.15	7,675	3.57

TABLE 78.—FATALITIES, BY CAUSES, AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 20 TO 39 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP II.

Year.	Killed underground.												Killed in shaft.						Killed on surface.						Total.	Grand total.	
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.			
1896.	33	1	10	2	4	1	1	1					63	2			1		6	1					1	70	
1897.	39	27	35	12	9	4	3	3		2	3		255	1			1		7	2					2	67	
1898.	155	31	19	31	14	25	1	6		1	1	2	248	4			2		13	10					12	274	
1899.	191	32	19	31	14	14		1		1	1		248	10					21	10					13	372	
1900.	118	55	11	6		39		12		1	1		523	12					32	12					14	293	
1901.	288	35	78	139	45	45		12		3	1		675	13					32	12					21	523	
1902.	319	34	8	139	45	40		12		3	1		675	13					32	12					21	798	
1903.	329	41	27	139	40	40		12		3	1		675	13					32	12					21	798	
1904.	318	22	17	7	40	39		12		3	1		450	11					24	13					32	721	
1905.	157	44	30	43	40	39		11		3	1		450	11					24	13					32	721	
1906.	194	38	41	32	43	39		11		3	1		450	11					24	13					32	721	
1907.	224	48	91	32	43	39		11		3	1		450	11					24	13					32	721	
1908.	191	55	58	41	51	44		11		3	1		450	11					24	13					32	721	
1909.	191	37	27	45	44	51		11		3	1		450	11					24	13					32	721	
1910.	100	16	34	6	44	9		11		3	1		450	11					24	13					32	721	
1911.	57	19	21	8	44	9		11		3	1		450	11					24	13					32	721	
1912.	124	23	37	43	44	8		11		3	1		450	11					24	13					32	721	
1913.	114	17	31	3	50	9		11		3	1		450	11					24	13					32	721	
Total	3,147	576	874	531	892	486	16	127	25	25	291	94	7,084	121	27	120	3		271	119	5	34	12	61	69	390	7,675





TABLE 80.—PERCENTAGE OF FATALITIES AND RATE PER 1,000 MEN EMPLOYED, BY PRINCIPAL CAUSES AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 40 TO 50 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP III.

[See fig. 11.]

	Falls of roof and pillar coal. (1 and 2)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 20)			Grand total.	
	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.
1895	6	74.25	3.77	5	45.45	2.11				1	11.29	0.13	1	14.29	0.13							11	4.71
1896	5	71.43	2.91	4	7.11	.43				4	7.14	.11										56	2.97
1897	40	71.43	1.51	15	18.18	.83				12	13.04	.27										88	2.15
1898	50	65.99	1.55	16	16.30	.81				16	13.63	.29										92	2.36
1899	47	51.69	1.05	15	16.30	.81	3	3.41	.08	12	13.04	.27	6	6.52	.13	3	3.41	.08	3	3.41	.08	117	2.14
1900	73	62.39	1.34	14	11.97	.66	3	2.56	.05	16	13.63	.29	7	5.68	.13	5	5.68	.13	5	5.68	.13	129	2.43
1901	91	70.54	2.07	14	10.85	.62	4	3.10	.09	11	8.53	.25	4	3.10	.09	1	1.77	.02	3	3.10	.09	137	2.87
1902	81	59.12	1.40	14	10.29	.54	5	3.65	.09	16	11.68	.28	9	6.57	.15	5	3.65	.09	27	5.11	.12	154	3.20
1903	325	63.25	2.03	69	13.13	.43	36	7.00	.22	25	4.86	.16	24	4.67	.15	15	2.84	.09	25	4.74	.15	320	3.61
1904	328	62.12	1.93	92	17.43	.54	11	2.08	.06	12	2.27	.07	45	8.52	.24	15	2.84	.09	26	4.50	.13	344	3.61
1905	328	62.12	1.79	110	13.03	.60	276	32.70	1.51	24	2.85	.12	29	4.62	.11	29	3.20	.10	26	3.85	.13	456	3.26
1906	299	45.58	1.49	85	12.96	.42	173	25.37	.86	23	3.51	.12	49	5.74	.21	21	3.20	.10	38	4.26	.20	885	3.87
1907	486	54.92	2.06	139	15.71	.59	127	14.35	.54	31	3.41	.12	95	6.52	.28	36	3.30	.11	55	4.81	.16	969	3.87
1908	542	50.62	2.01	167	18.37	.62	222	2.42	.08	31	3.41	.12	95	6.52	.28	23	2.07	.07	52	4.81	.16	1,081	3.29
1909	606	56.06	1.80	209	17.58	.61	109	7.58	.32	39	3.52	.11	71	6.41	.20	23	2.07	.07	75	6.79	.21	1,108	3.21
1910	584	52.71	1.69	209	18.86	.61	109	9.84	.33	29	2.35	.08	94	7.63	.26	18	1.46	.05	75	6.69	.29	1,232	3.36
1911	652	52.92	1.78	244	19.81	.66	120	9.74	.33	29	2.35	.08	94	7.63	.26	18	1.46	.05	75	6.69	.29	1,232	3.36
1912																							
1913																							
Total	4 551	54.22	1.79	1 387	16.52	.55	974	11.60	.39	308	3.67	.12	536	6.39	.21	207	2.47	.08	431	5.13	.17	8 394	3.31

TABLE 81.—FATALITIES, BY CAUSES, AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 40 TO 59 PER CENT OF THE COAL WAS MINED BY MACHINES, GROUP III.

Year.	Killed underground.												Killed in shaft.					Killed on surface.					Total.	Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.			Railway cars and loco-motives.	Other causes.	
1896.....	3	3	5										11							17						11	11
1897.....	1	4											49							3						7	7
1898.....	34	6	16			1		1				1	81			4			4				2			3	56
1899.....	52	6	4			4							81			1			4				1			3	88
1900.....	39	8	15	3		1		1					83	3	2	1			1		1		1			5	92
1901.....	96	7	14	3		16							113	1	1	1			1							3	117
1902.....	66	12	14	4		12				1			124	4	1	2			1							1	129
1903.....	79	11	13			11		2		5			135	4	1	2			3							1	137
1904.....	70	11	14		5	16	1	2	2	5			135	4	1	2			8							3	142
1905.....	283	42	69	23	13	25	2			6			479	7	3	2			15							6	514
1906.....	288	40	92	11	239	12	1	28	2	3			488	7	3	2			29							7	528
1907.....	289	39	110	37	239	24	25	1	5	1			777	15	2	12			21							3	584
1908.....	290	39	85	10	163	23	22	1	4	2			609	5	2	14			21							5	609
1909.....	415	71	139	13	114	26	23	22	1	3			827	10	3	7			20							3	656
1910.....	464	78	167	22		31	51	2	6	5			894	14	3	16			30							4	885
1911.....	498	108	190	49	33	35	1	68	4	5			1,008	13	1	8			33							10	909
1912.....	504	80	209	24	85	39	1	46	3	5			1,012	11	2	10			23							17	1,081
1913.....	537	115	241	15	105	29	1	55	3	13	2		1,139	12	1	4			23							18	1,108
Total.....	3,892	669	1,387	217	757	308	7	343	18	53	20	95	7,756	101	18	86	2	207	181	25	53	21	50	101	431	8,394	

TABLE 82.—PRODUCTION, MEN EMPLOYED, AND NUMBER KILLED IN AND ABOUT THE BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 60 PER CENT AND OVER OF THE COAL WAS MINED BY MACHINES, 1896 TO 1913, INCLUSIVE, **GROUP IV.**

[See figs. 9, 12, and 13.]

Totals for States in Group IV having accident statistics.																	
Year.	Grand totals, Group IV.				Production (short tons).	Per-centage mined by machine.	Men em-ployed.	Days active.	Number killed.			Number killed per 1,000 employed.			Num-ber killed per million tons mined.	Tons mined per man.	
	Production (short tons).	Men em-ployed.	Tons mined per man.	Total.					In excep-tional acci-dents.	In com-mon acci-dents.	Total.	In excep-tional acci-dents.	In com-mon acci-dents.	Per year.		Per day.	
1896.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1897.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1898.....	83,895	151	556	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1899.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1900.....	1,061,775	2,376	699	62.90	2,376	212	7	.....	.....	.....	.....	.....	.....	.....	.....	699	2.77
1901.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1902.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1903.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1904.....	25,552,950	43,399	589	66.10	43,399	176	126	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1905.....	27,731,640	45,438	610	72.14	45,438	167	131	5	.....	.....	.....	.....	.....	.....	.....	.....	.....
1906.....	32,132,419	46,833	686	77.30	46,833	199	154	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1907.....	36,270,639	47,407	554	75.37	47,407	161	113	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1908.....	38,637,025	55,017	702	74.04	55,017	203	144	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1909.....	48,832,087	66,957	729	78.32	66,957	208	245	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1910.....	44,809,689	69,583	644	79.77	69,583	187	151	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1911.....	51,019,248	69,831	731	80.36	69,831	201	186	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1912.....	51,019,248	69,831	731	80.36	69,831	207	216	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913.....	57,048,913	75,452	756	83.89	75,452	207	216	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	353,791,180	522,444	677	77.48	522,293	192	1,473	107	1,366	2.82	.20	.....	4.16	677	.....	3.53	.....



TABLE 83.—PERCENTAGE OF FATALITIES AND RATE PER 1,000 MEN EMPLOYED, BY PRINCIPAL CAUSES AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 60 PER CENT AND OVER OF THE COAL WAS MINED BY MACHINES, GROUP IV.

(See fig. 11.)

Year.	Falls of roof and pillar coal. (1 and 20)			Mine cars and locomotives. (3)			Gas and dust explosions. (4 and 5)			Explosives. (6)			Miscellaneous underground. (7 to 12)			Total shaft fatalities. (13 to 16)			Total surface fatalities. (17 to 22)			Grand total.	
	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Percentage of total killed.	Number killed per 1,000 employed.	Number killed.	Number killed per 1,000 employed.
1896.....																							
1897.....																							
1898.....																							
1899.....																							
1900.....																							
1901.....	4	57.14	1.69	1	14.29	0.42				2	28.57	0.84											
1902.....																							
1903.....																							
1904.....																							
1905.....																							
1906.....																							
1907.....																							
1908.....																							
1909.....																							
1910.....																							
1911.....																							
1912.....																							
1913.....																							
Total.....	897	60.90	1.72	177	12.02	34	102	6.82	19	80	5.43	15	114	7.74	22	32	2.17	.06	71	4.82	.14	1,473	2.82

TABLE 84.- FATALITIES, BY CAUSES, AT BITUMINOUS COAL MINES IN THE UNITED STATES IN WHICH 60 PER CENT AND OVER OF THE COAL WAS MINED BY MACHINES, GROUP IV.

Year.	Killed underground.												Killed in shaft.						Killed on surface.						Grand total.	
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	(Gas explosions and burning gas.	(Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.		Total.
1896.....																										
1897.....																										
1898.....																										
1899.....																										
1900.....	1	3	1										7													
1901.....																										
1902.....																										
1903.....																										
1904.....																										
1905.....	71	1	16	1	1	4		6		4	1		110	1				3	2		1	4	1	5	13	126
1906.....	55	3	12	3	3	12		9	2				118	1	1	2		10	3	1	2	3			3	131
1907.....	93	3	17	3	3	4		10			5		140	1				1	3						3	154
1908.....	71	3	17	1	1	6		3					105	1	1			1	1						6	113
1909.....	86	7	23	8	2	4		3					138	1				2	1						5	144
1910.....	114	7	21	16	40	11		9			1		232	1		2		3	6		1	1			10	245
1911.....	106	8	16	5	5	6		6					146	1		3		4	1		2				5	181
1912.....	119	9	21	1	5	7		7			4		171	6		1		4	1		2				11	186
1913.....	116	4	23	15	5	7		13			6		203	6		1	1	4	1						5	216
Total .....	845	62	177	55	47	80	5	68	2	22	17		1,370	13	2	16	1	32	22	1	7	8	15	16	71	1,473





## PART II.—COAL-MINE STATISTICS FOR EACH STATE BY CALENDAR YEARS.

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### INTRODUCTION.

The following pages give detailed information of the coal-mining industry by States, arranged in alphabetical order, and calendar years. Most of the information has a bearing on the accident hazard. Comments are made on the coal-bearing area of each State, the character of the coal beds, that is, whether the beds are thick or thin, flat or inclined, and data are given concerning the roof conditions. There are also notes on the methods of mining, whether long-wall, room-and-pillar, etc., with statements as to whether the coal is mined by hand, machine, or shot off the solid.

In the State tables are complete figures for the production of coal from the beginning of the industry to the end of 1914; also the number of men employed, the number of fatalities, and the fatality rates per 1,000 men employed and per million tons of coal produced since the beginning of inspection service. The tables also give the number of days the mines were operated each year, the number of tons of coal mined per man, per day, and per year, together with the number of mining machines in use since 1891, or since their introduction into the mines, if adopted at a later date.

There is also for each State one table showing all the fatalities by causes and calendar years, for which complete records are available, and with this as a start it should be an easy matter for each State to continue its records on the calendar-year basis. There will also be found under each State data as to the number of hours worked per day and the number of men employed in each group of 8, 9, or 10 hour workers. Fatality rates have also been calculated on the basis of a uniform year of 2,000 hours, so that true comparisons of one State with another may be readily made. Under each State will also be found a list of all of the mine disasters in which five or more men were killed at one time. The last table under each State gives data concerning strikes and lockouts, showing the number of men involved and the total amount of time lost.

While the area of the coal fields will be found under each State, the accompanying table shows, in addition, the estimated original supply, the production in 1913, and the total production to the close of 1913; and in the last column is shown the estimated available supply of coal in the various States at the close of 1913 as estimated by the United States Geological Survey.

AREAS OF THE COAL FIELDS BY STATES, ESTIMATES OF ORIGINAL AND PRESENT SUPPLY, AND THE PRODUCTION TO THE CLOSE OF 1913.<sup>a</sup>

	Area.	Estimated original supply.	Production in 1913.	Total production to close of 1913.	Total exhaustion to close of 1913.	Estimated available supply.
	<i>Square miles.</i> (b)	<i>Short tons.</i> (c)	<i>Short tons.</i> (b)	<i>Short tons.</i> (c)	<i>Short tons.</i> (c)	<i>Short tons.</i> (c)
ANTHRACITE.	480	21,000,000,000	91,524,922	2,446,696,010	4,847,000,000	16,153,000,000
Colorado and New Mexico.....						
Total.....	480	21,000,000,000	91,524,922	2,446,696,010	4,847,000,000	16,153,000,000
BITUMINOUS. <sup>c</sup>						
Atlantic coast region:	150	(d)	(d)	(d)	(d)	(d)
Virginia.....	60	200,000,000		477,125	715,700	199,284,300
North Carolina.....						
Appalachian region:						
Pennsylvania.....	14,200	112,574,000,000	173,781,217	2,731,945,059	4,100,000,000	108,474,000,000
Ohio.....	12,000	93,967,900,000	36,100,517	682,678,346	1,024,000,000	92,943,900,000
Maryland.....	4,455	8,044,000,000	4,779,839	175,653,679	263,300,000	7,780,700,000
Virginia.....	1,750	22,500,000,000	8,828,068	96,287,781	134,300,000	22,365,700,000
West Virginia.....	17,000	151,544,900,000	71,308,982	787,543,870	1,181,300,000	150,363,600,000
Eastern Kentucky.....	10,270	67,787,000,000	11,098,960	93,423,911	1,140,000,000	67,647,000,000
Tennessee.....	4,400	25,665,000,000	6,903,784	123,793,965	186,000,000	25,479,000,000
Georgia.....	167	933,000,000	255,626	9,435,298	14,200,000	918,800,000
Alabama.....	8,455	67,583,000,000	17,678,322	254,954,358	382,400,000	67,200,600,000
Total.....	69,357	550,598,800,000	330,835,525	4,955,706,467	7,425,900,000	543,172,900,000
Northern region:						
Michigan.....	11,000	12,000,000,000	1,231,786	22,911,711	34,400,000	11,965,600,000
Eastern region:						
Indiana.....	6,500	53,051,000,000	17,165,671	251,632,098	377,500,000	52,673,500,000
Western Kentucky.....	6,400	55,540,000,000	8,517,640	114,704,743	172,000,000	55,368,000,000
Illinois.....	35,600	201,399,800,000	61,618,744	965,516,323	1,448,300,000	199,951,500,000
Total.....	48,500	309,940,800,000	87,302,055	1,331,853,164	1,997,800,000	307,955,000,000

<sup>a</sup> Mineral Resources, U. S. Geological Survey, 1913.<sup>b</sup> Included in Rocky Mountain and Northern Great Plains provinces.<sup>c</sup> Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.<sup>d</sup> Included in production of Appalachian region.

AREAS OF THE COAL FIELDS BY STATES, ESTIMATES OF ORIGINAL AND PRESENT SUPPLY, AND THE PRODUCTION TO THE CLOSE OF 1913—Contd.

Area.		Estimated original supply.	Production in 1913.	Total production to close of 1913.	Total exhaustion to close of 1913.	Estimated available supply.
<i>BITUMINOUS—continued.</i>						
<i>Interior province—Continued.</i>						
<i>Western and south-western regions: a</i>						
Iowa.....	Square miles. 12,560	Short tons. 29,150,000,000	Short tons. 7,535,996	Short tons. 180,000,000	Short tons. 280,000,000	Short tons. 28,850,000,000
Missouri.....	25,360	81,000,000,000	4,318,123	1,010,000,000	180,000,000	83,810,000,000
Kansas.....	18,000	30,000,000,000	7,302,250	129,000,000	104,000,000	29,896,000,000
Arkansas.....	7,350	1,887,000,000	2,202,107	36,500,000	55,000,000	1,832,000,000
Oklahoma.....	10,000	54,951,000,000	4,166,770	30,474,000	89,200,000	54,862,000,000
Texas.....	48,500	31,000,000,000	2,426,144	26,649,200	40,000,000	30,959,000,000
Total.....	141,200	259,998,500,000	27,875,292	559,151,372	888,700,000	259,139,800,000
<i>Rocky Mountain and Northern Great Plains provinces.</i>						
Arizona.....	3,610	14,151,000,000				14,151,000,000
North Dakota.....	35,980	697,929,000,000	105,320	5,435,516	8,200,000	697,921,200,000
Montana.....	39,532	281,115,800,000	3,240,973	41,400,050	62,000,000	281,053,800,000
South Dakota.....	19,940	1,040,300,000				1,040,300,000
Wyoming.....	41,540	670,735,000,000	7,303,066	118,700,008	178,000,000	670,557,000,000
Utah.....	11,176	88,315,500,000	3,254,828	34,252,864	51,400,000	88,264,100,000
Colorado.....	19,754	317,852,000,000	9,224,510	175,301,698	262,000,000	317,590,000,000
New Mexico.....	14,220	191,800,000,000	3,708,806	41,400,000	62,200,000	191,737,800,000
Idaho.....	1,240	700,000,000	6,217	75,000	75,000	699,925,000
Total.....	178,022	2,363,678,200,000	27,327,680	316,724,254	624,873,000	2,363,053,327,000
<i>Pacific coast provinces and Alaska.</i>						
Washington.....	1,800	63,873,000,000	3,877,801	64,450,440	95,700,000	63,757,300,000
Oregon.....	250	1,000,000,000	46,063	2,165,871	3,700,000	996,294,000
California.....	40	44,000,000	24,839	5,157,204	7,735,000	36,265,000
Alaska.....			2,672	47,969		
Total.....	2,070	64,917,000,000	3,970,865	71,826,494	107,085,000	64,809,417,000
Total production including ordinary consumption.....	6479,879	3,571,383,000,000	579,048,125	9,844,247,843	15,877,071,700	3,555,366,328,200

a Including Arkansas and Texas in the field of Gulf province.

b Includes a little coal from Nevada.

c These are 59,482 square miles supposed, but not definitely known, in which the coal lies under over 3,000 or more feet in thickness.



**ALABAMA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The Alabama coal fields form the southwestern end of the Appalachian coal region, which extends from Pennsylvania to Alabama. There are four distinct fields: The Coosa field, on the southeast; the Cahaba field, somewhat west of the Coosa; the Warrior field, 7 to 10 miles west of the Cahaba field; and the Plateau field, in the northeast corner of the State and northeast of the Warrior field, and not entirely separate therefrom. These fields were originally connected, but have been separated since their formation by erosion along the lines of faults or anticlines. The total remaining area is now about 8,500 square miles not including the area, probably of considerable size, beneath younger rocks to the southwest of the visible margin of the coal-bearing rocks.

**COOSA FIELD.**

The Coosa field, or basin, is a structural trough 6 miles wide extending for 60 miles through Shelby and St. Clair counties and containing about 260 square miles. It is faulted along its southeast margin, so that in general only the western half of the trough remains. The coal beds dip to the southeast at angles varying with the locality from  $10^{\circ}$  to  $50^{\circ}$ . However, the structure is less simple than the above description indicates, for at the north end there are a number of small subordinate basins due to local faults and folds, and in the southern two-thirds, the structure, although it is rather more regular, is affected by internal faults and folds. The conglomerate, sandstone, and shale, which comprise the coal-bearing rocks, are of great thickness, probably not less than 10,000 feet as a maximum. The best known part of the field is the northeast, where there are 18 coal beds, each of which varies considerably in thickness from place to place, the minimum thicknesses varying from zero to  $2\frac{1}{2}$  feet and the maximum thicknesses from 8 inches to 5 feet 8 inches. These beds lie in the small subordinate basins above mentioned and in the upper 4,000 feet of the rocks, so that their total area is probably not over one-tenth of the area of the field, say 35 square miles. In the other parts of the Coosa trough the coal beds are not so well known but appear to be few and comparatively thin. Excepting two beds the character of the Coosa coals has not been adequately determined. So far as shown by the tests made, the coal is high-grade bituminous with low sulphur and medium ash contents and of about the hardness of the southern Appalachian coals generally. One bed is reported to yield good coking coal.

## CAHABA FIELD.

The Cahaba field, or basin, like the Coosa field, is a synclinal trough lying a few miles west of the Coosa field. It is about 68 miles long and extends from the northeastern part of Bibb County through Shelby County into St. Clair County, its average width is about 6 miles except in the southwest third where it expands to twice that width, and its area is about 350 square miles.

Like the Coosa field the eastern half of the Cahaba trough is faulted, except for a few miles at the south end, where the southeast limb of the syncline in a vertical or slightly overturned attitude is preserved. Along the western margin of the trough the dip varies from  $10^{\circ}$  to  $60^{\circ}$  southeast. In the north half of the field this southeast dip prevails to the fault in the southeast, but extending along the middle of the southern half of the field the southeast dip is interrupted by a high anticline with a vertical dip on the northwest limb and a dip of  $40^{\circ}$  on the southeast limb near the crest, but diminishing gradually to a low dip southeastward to the boundary fault, except for the few miles where the southeast limb of the trough is preserved. In this area the rocks bend abruptly upward and stand vertical at the surface. In addition to these major folds, there are a number of subordinate basins along the southeastern margin, caused by transverse folds with dips of all degrees up to vertical. Several faults of varying magnitude are known, but apparently faults are few.

The coal-bearing strata, conglomerate, sandstone, and shale, are about 9,000 feet thick in the southern part of the field and about 5,000 feet in the northern part.

In the southern part there are at least 17 coal beds that in some part of their extent are 2 feet or over in thickness, the thickest bed being 5 to 6 feet. Most of the beds, with the exceptions of local thinning or thickening, range from 2 to 4 feet in thickness.

The coal is high-grade bituminous with a low to medium ash content, a generally low sulphur content, and, as a rule, is of average hardness. It is said to make a good quality of coke, but the yield is lower than the Warrior coals, so that the product is all consumed as domestic, steam or gas coal.

## WARRIOR FIELD.

The Warrior coal field, or basin, lies 7 to 10 miles west of the Cahaba field and extends westward nearly to the State boundary. It is a quadrangular area, including all or parts of the following counties: Jefferson, Walker, Tuscaloosa, Fayette, Marion, Franklin, Lawrence, Winston, Cullman, Morgan, and Blount. The Warrior field is not

definitely separated from the Plateau field on the northeast, and their limits have not yet been definitely defined. The combined area of the two fields is about 7,600 square miles. Along the southeast edge of the Warrior field the strata dip  $90^{\circ}$  to  $40^{\circ}$ , or less, to the west; but throughout the remainder of the field are nearly flat or gently and broadly warped. The rocks, conglomerate, sandstone, or shale are about 3,000 feet thick.

The number of workable coal beds is about fifteen. They constitute the following groups from below upward: Black Creek, Mary Lee, Pratt, and Brookwood, each named from its most important coal bed. The bottom of the Black Creek group is about 900 feet above, and the top of the Brookwood is about 2,300 feet above, the bottom of the coal-bearing rocks, so that the main coal beds extend through about 1,400 feet of strata.

The Black Creek, the lowest and most extensive bed, averages about 3 feet thick and is an excellent domestic coal, for which it is mainly used. The Mary Lee group contains five beds, but at all points one "big seam," which possibly may be everywhere the same bed, or at different points may be one or another of the five beds. This "big seam" is of great areal extent, varies from 5 to 10 feet in thickness, and includes many thin or a few thick clay partings. The Pratt group likewise contains five coal beds, of which three are important, one of the three being the Pratt bed, which over large areas is 3 to 5 feet thick, with at some places a thin parting or two and at others being all clean coal. The Brookwood group includes three or four beds, of which the Brookwood bed is the most important, being 3 to 7 feet thick. This group, being high in the coal-bearing rocks, occupies only a relatively small area in Tuscaloosa County. The "Big seam," Pratt, and Brookwood beds are the thickest in the Warrior basin. In 1899 the Pratt beds yielded 65 per cent of the total coal production from the basin, and in recent years about 33 per cent.

The average composition of 23 samples of the different coal beds of the Warrior basin is approximately as follows: 2.4 per cent moisture, 28.4 per cent volatile matter, 59 per cent fixed carbon, 10.2 per cent ash, and 1.74 per cent sulphur. It is a high-grade bituminous coal of medium hardness and a domestic steam and coking coal. Practically all the coke consumed in the State is made from coal from the "Big seam," Pratt bed, and the beds of the Brookwood group, of which the principal one is the Brookwood.

#### PLATEAU FIELD.

The Plateau field comprises a long belt on Sand Mountain extending from the Warrior field, with which it is continuous on the south-



west, to the northeast corner of the State, a number of detached areas to the northwest of the Sand Mountain belt, the detached area of Lookout Mountain, and the semi-detached area of Blount Mountain on the southeast of Sand Mountain. These various areas lie mainly in Madison, Jackson, DeKalb, Etowah, Marshall, and Blount Counties.

The character of the rocks is the same as in the other fields, but their thickness and the number and thickness of coal beds are not well known. There are perhaps four or six different beds, more or less local in extent, which range from 2 to 4 feet in thickness.

Except on the western edge of Blount Mountain, where the rocks are vertical, the dip is slight and in most parts of the field the rocks are nearly flat.

#### MINING METHODS.

Coal mining was first begun in the Coosa basin in 1836, and in the Cahaba field in 1856. General uniformity in mining methods prevails throughout the Birmingham district with the exception of slight modifications which are rendered necessary by differences in the geologic structure. In the Coosa and Cahaba basins the coal-bearing strata generally dip from  $5^{\circ}$  to  $30^{\circ}$ , but, as on the southeastern margin of the Cahaba basin, the dip is  $60^{\circ}$  or in places even  $90^{\circ}$ . Practically all of the mines are opened by slopes, the main entry following the dip of the coal. From these slopes the coal is mined by the room-and-pillar system. In the central and western parts of the Warrior field, where the coal beds are nearly flat and the coal is above the drainage levels, the mines are opened almost exclusively by drifts. Along the southeastern margin of the Warrior basin, where the dip is  $40^{\circ}$  to  $90^{\circ}$ , the mines are opened by slopes: at a few mines shafts are employed for reaching the lower coal. Shafts are also used in the southern part of the basin where the coal-bearing formations pass below the drainage level. The room-and-pillar system of mining also prevails in this part of the district. In 1899 only one mine was reported as using the long wall system, and only  $3\frac{1}{2}$  per cent of the output was mined by machines, whereas in 1913 the machine-mined coal amounted to 23.3 per cent. The number of machines in operation in 1899 was 53, and in 1913, 377. In 1912, 35.1 per cent of the coal was shot off the solid, and in 1913, 39.9 per cent, an increase of 5.8 per cent. Tail rope, endless rope, electric, and mule haulage are employed.

#### ROOF.

So far as the character of the roof is concerned, whether sandstone or shale, it is generally strong. The roof of the Thompson bed

(southern part of the Cahaba field) is of shale 10 feet thick that slakes rapidly and falls badly, so that it is necessary to put in heavy timber in the main haulage ways. A fragile shale roof is reported in a few mines.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The office of inspector of mines of Alabama was created by an act approved February 18, 1891, applying to all coal, iron, or other mines where 20 or more men were employed underground. The inspector was appointed by the governor, and was required to examine every mine at least once every three months. By an act approved February 16, 1893, the operators were required to notify the inspector of fatal accidents, and the inspector, at the operator's request or the request of three miners, examined into the cause of such accidents, and preserved in his office a record of each accident of which he received notice. Biennial reports were rendered to the governor. The act of February 18, 1895, made it the duty of mine operators to report to the inspector serious as well as fatal accidents in and about the mines. A chief inspector and two associate mine inspectors were provided for by the act of February 16, 1897, the chief inspector to report biennially to the governor. The act of April 18, 1911, authorized the governor to appoint an inspector of coal mines for each  $2\frac{1}{2}$  million tons of coal mined, or majority fraction thereof, based on the output for previous years as compiled by the chief mine inspector, one of the inspectors so appointed to be designated chief inspector, and the others associate inspectors, and one of them to be a mining engineer. The law required the inspector to report to the governor before the legislature convened.

The practice of mine operators in Alabama is to report to the inspectors all accidents causing 10 days' disability. A serious injury is considered as one causing disability for 30 days, a slight injury being one which disables an employee 1 to 29 days. Only the serious injuries are published in the inspector's annual reports.

In 1915 there were one chief inspector and six district inspectors.

#### ACCIDENTS.

The accompanying tables show the number of fatalities by causes and calendar years since 1893 as compiled from the State mine inspectors' annual reports. These tables also show the percentage of accidents, classified by principal causes, and the fatality rate per 1,000 men employed over a period of 21 years for which continuous records

are available. The fatality rate during this period is 5.25 per 1,000 men employed. Since 1897 to the end of 1913 there have been 12 disasters in which 5 or more men were killed at one time, representing a total of 500 fatalities, or approximately 27 per cent of the total

FATALITIES IN ALABAMA COAL MINES, BY PRINCIPAL CAUSES, DURING 21 YEARS, 1893 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	713	38.31	2.01
Mine cars and locomotives.....	193	10.37	.55
Gas and dust explosions.....	620	33.32	1.75
Explosives.....	96	5.16	.27
Miscellaneous.....	203	10.91	.57
Shaft.....	8	.43	.02
Surface.....	28	1.50	.05
Total (21 years).....	1,861	100.00	5.25

COAL-MINE ACCIDENTS IN ALABAMA IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1897 Sept. 20.....	Belle-Ellen.....	Belle-Ellen.....	Mine fire.....	5
1899 Feb. 21.....	Blocton No. 2.....	Blocton.....	Mine explosion.....	5
1905 Feb. 20.....	Virginia City.....	Virginia City.....	do.....	108
1906 Feb. 27.....	Little Cahaba.....	Piper.....	do.....	12
1907 Dec. 16.....	Yolande.....	Yolande.....	do.....	56
1909 Feb. 2.....	Short Creek.....	Short Creek.....	do.....	16
1910 Apr. 20.....	Mulga.....	Mulga.....	do.....	40
1910 May 5.....	Palos No. 3.....	Palos.....	do.....	83
1910 Nov. 3.....	Yolande No. 1.....	Yolande.....	do.....	5
1911 Apr. 8.....	Banner.....	Littleton.....	do.....	128
1912 Aug. 13.....	Abernant.....	Abernant.....	do.....	18
1913 Nov. 18.....	Acton No. 2.....	Acton.....	do.....	24
1914 Jan. 10.....	Rock Castle.....	Rock Castle.....	do.....	12
1914 Oct. 5.....	Mulga.....	Mulga.....	do.....	16

killed from 1893 to 1913. Falls of roof are responsible for 38.31 per cent of all the fatalities since 1893; gas and dust explosions combined represent 33.32 per cent. The average production of coal per fatality was 118,865 tons, or there were 8.41 fatalities per million tons mined.

Since 1903 practically 62 per cent of the men employed in the mines of Alabama have been on a 10-hour basis. This alone partly accounts for the higher rate when compared with Iowa or Ohio, in which States all of the men are on an 8-hour day. The average number of hours worked a year per man is 2,255, as compared with 1,495 for Ohio or 1,704 for Iowa (Table 40). The fatality rate reduced to a 2,000-hour basis becomes 5.78 for the 10-year period 1903-1913, as compared with 6.52 per 1,000 men actually employed.



# 142 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **ALABAMA**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	20	935	34	7,665	61	10,746	2,092	21,438
1904.....	17	876	50	5,763	50	8,409	2,763	17,811
1905.....	24	1,069	32	3,570	65	11,279	3,677	19,595
1906.....	27	1,096	37	7,808	91	11,258	393	20,555
1907.....	31	1,994	34	2,339	84	13,942	3,113	21,388
1908.....	16	1,205	34	2,358	100	11,969	3,665	19,197
1909 <sup>b</sup> .....								17,760
1910.....	18	766	36	2,633	134	17,306	1,525	22,230
1911.....	15	550	50	5,345	102	12,628	3,480	22,003
1912.....	11	338	46	4,145	107	13,938	4,192	22,613
1913.....	13	420	36	2,496	135	18,185	3,451	24,552

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **ALABAMA** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees.)	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	228	202,753	46,227,684	23,114	57	2.47
1904.....	216	167,832	36,251,712	18,126	83	4.58
1905.....	225	186,565	41,977,125	20,989	187	8.91
1906.....	237	195,157	46,252,209	23,126	96	4.15
1907.....	242	204,440	49,474,480	24,737	154	6.23
1908.....	222	183,537	40,745,214	20,373	108	5.30
1909.....						
1910.....	249	216,610	53,935,890	26,968	238	8.82
1911.....	227	210,105	47,693,835	23,847	209	8.77
1912.....	245	217,117	53,193,665	26,597	123	4.62
1913.....	255	238,733	60,876,915	30,439	124	4.07

Tables have been compiled showing the fatality rates for all the States both on the basis of actual employees and the number of 2,000-hour workers, so that by referring to Tables 40 and 41 a true comparison of Alabama with other States may be readily made. The tables of statistics for the State follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN  
**ALABAMA.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	1,135	68,925	61	1907.....	80	3,600	45
1900.....	1,056	50,620	48	1908.....	8,397	373,513	44
1901.....	1,170	14,071	12	1909.....	25	1,250	50
1902.....	6,059	139,783	23	1910.....	210	1,260	6
1903.....	7,319	231,112	32	1911.....	384	12,323	32
1904.....	9,518	762,032	80	1912.....	1,048	27,041	26
1905.....	667	33,262	50	1913.....	320	3,940	12
1906.....	549	6,576	12	1914.....			

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 85.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN ALABAMA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal line in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 compiled from State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.			Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
			Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.	Per year.	Per day.	Hand.			Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axle or post.	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
1840-1886	10,944,018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								



1912.....	16,100,600	1.29	22,613	123	5.44	7.64	130,899	245	712	2.91	41.4	23.2	35.1	.3	222	60	12	59	.....	353	217
1913.....	17,678,522	1.31	24,552	124	5.05	7.01	142,569	255	720	2.82	35.7	23.3	34.9	1.1	249	42	20	66	.....	377	224
Total.....	254,954,368			1,861																	
Average (1893-1913).....	10,533,707	1.34	24,042	123	5.32	8.41	118,865	239	695	2.62	32.9	31.7	35.3	.1	223	31	20	88	.....	362	207
1914.....	15,593,422																				

a Not reported.

TABLE 86.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN ALABAMA, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1893 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1893.....	13	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	15	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	2
1894.....	11	1	2	.....	.....	.....	.....	.....	.....	.....	4	20	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	2
1895.....	19	4	6	3	.....	2	.....	.....	.....	.....	.....	36	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	2
1896.....	16	2	3	.....	.....	.....	.....	.....	.....	.....	.....	2	25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
1897.....	17	2	4	4	.....	3	.....	.....	.....	.....	5	38	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
1898.....	22	2	9	10	.....	.....	.....	.....	.....	.....	.....	1	44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
1899.....	18	3	5	5	.....	.....	.....	.....	.....	.....	.....	9	36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1900.....	17	2	4	2	.....	3	.....	.....	.....	.....	.....	9	37	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1901.....	18	6	6	2	.....	6	.....	.....	.....	.....	.....	8	48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1902.....	29	.....	9	.....	.....	10	.....	.....	.....	.....	.....	8	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1903.....	20	2	6	18	.....	3	.....	.....	.....	.....	.....	9	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1904.....	34	4	7	26	.....	3	.....	.....	.....	.....	.....	9	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
1905.....	31	3	8	19	.....	4	.....	.....	.....	.....	.....	2	90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1906.....	45	5	12	13	.....	7	.....	.....	.....	.....	.....	2	107	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1907.....	21	3	11	5	57	3	.....	.....	.....	.....	.....	52	154	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1908.....	36	3	16	9	.....	12	.....	.....	.....	.....	.....	22	108	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1909.....	61	9	17	6	.....	10	.....	.....	.....	.....	.....	7	128	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1910.....	51	4	20	.....	18	2	.....	.....	.....	.....	.....	7	237	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1911.....	43	4	14	.....	128	5	.....	.....	.....	.....	.....	2	204	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1912.....	56	6	15	26	.....	5	.....	.....	.....	.....	.....	2	117	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1913.....	61	7	19	.....	.....	2	.....	.....	.....	.....	.....	2	123	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6
1914.....	53	.....	24	37	.....	1	.....	.....	.....	.....	.....	2	127	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6

a Explosion at Acton No. 2 mine, killed 24.

## ARKANSAS.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The semibituminous coal field of Arkansas occupies the west-central part of the State, having a length from east to west of 75 miles. At the Oklahoma-Arkansas line it is about 50 miles wide and at the eastern extremity about 25 miles wide. It comprises about 1,580 square miles, of which 75 per cent is considered as productive. The coal-bearing rocks occupy the larger part of Crawford, Franklin, Sebastian, Johnson, and Logan counties.

The lignite field of Arkansas occupies the eastern part of the State and is possibly coextensive with the Tertiary rocks of the Mississippi Valley. The estimated area of these rocks is 6,000 square miles, but workable lignite has been discovered at only a few places, and at no place is it mined on a commercial scale.

### SEMIBITUMINOUS FIELD.

The semibituminous field is the eastward extension of the Oklahoma fields, but in Arkansas there is only one coal bed of commercial importance, the Hartshorne, which lies just above the massive Hartshorne sandstone and at the base of the Spadra shale. This coal is mined extensively in the vicinity of Huntington, Midland, Greenwood, and Jenny Lind, in the western part of the field, and is from 3 feet to 8 feet thick. Where the bed is less than 4 feet thick, it is generally clean coal, but where the thickness increases to 6 or 8 feet the bed is broken by many soft shale partings.

The field as a whole is a broad, open synclinal basin or trough, with many minor folds and faults that break the regularity of outline and seriously interfere with economical mining. The Hartshorne coal bed outcrops around the rim of the basin, but only part of the exposed outcrop is thick enough to mine under present conditions.

The coal is of high rank, comparing favorably with the Pocahontas and New River coals of the Appalachian region. In the west end of the field it is semibituminous, but its rank increases eastward to semi-anthracite about Spadra and Russellville.

### MINING METHODS.

The first records of coal production in Arkansas extend back to 1840, when 220 tons of coal were mined. The production has gradually increased to 1913, when 2,234,107 tons were produced. Most of the mines are opened by shafts, but a few are opened by slopes. The room-and-pillar method of mining prevails throughout the State. About 99 per cent of the coal produced comes from the Huntington field, from what is known as the Hartshorne seam of Oklahoma.

Coal-mining machines were used in Arkansas in 1896, at which time there were 14 machines in operation, producing about 3 per cent of the coal. Fifteen to 20 machines were kept in operation until the close of 1902, and from that year until 1910 no mining machines were used in the State. In 1911 there were 14 machines in use, producing a little more than 1 per cent of the coal mined. In 1913 there were 27 machines, producing slightly over 11 per cent of the coal. In 1912, 92 per cent of the coal was shot off the solid; in 1914, 78 per cent was thus mined.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

By an act approved March 7, 1889, the legislature of Arkansas established a Bureau of Mines, Manufactures, and Agriculture, under the supervision of a commissioner, whose duties included the collection and publication of statistics setting forth the extent of the mineral resources of the State, the purpose being to encourage immigration to Arkansas. The act made no provision for the investigation or reporting of mine accidents, but a subsequent law, approved April 4, 1893, which was still in force in 1914, provided for the appointment by the governor of a mine inspector, to whom all fatal or serious accidents in coal mines should be reported by mine operators. The inspector investigates all fatal accidents to determine the cause thereof. He is required to personally inspect all coal mines in the State where 20 or more men are employed underground, to insure the safety and health of the workmen, and to see that the provisions of the act are properly observed and enforced. The act is not applicable to mines employing less than 20 men. Annual reports are rendered to the governor on the 1st day of November of each year.

Mine operators report to the inspector all injuries resulting in at least two days' disability, and these are included in the annual reports which the inspector renders to the governor. Injuries involving 10 or more days' disability are classified as serious, all others being considered slight injuries.

In 1915 the inspector employed no assistants.

#### ACCIDENTS.

The accompanying tables (Nos. 87 and 88) give the production, number of employees, and number of men killed in and about the coal mines of Arkansas, compiled from the best records available. The accident records began with 1897, although the inspection service began at an earlier date. There are no records for the years 1899, 1900, and 1904, and the record for 1903 is incomplete. For the 9-year period for which continuous records are available, 1905 to 1913, inclusive, 107 men were killed, representing a fatality rate



# 148 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

FATALITIES IN **ARKANSAS** COAL MINES, BY PRINCIPAL CAUSES, DURING 9 YEARS, 1905 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	65	60.75	1.46
Mine cars and locomotives.....	2	1.87	.05
Gas and dust explosions.....	2	1.87	.05
Explosives.....	15	14.01	.34
Miscellaneous.....	20	18.69	.45
Shaft.....	2	1.87	.05
Surface.....	1	.94	.02
Total, 9 years.....	107	100.00	2.42

COAL-MINE ACCIDENTS IN **ARKANSAS** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number of men killed.
1897 Mar. 4.....	Kansas and Texas No. 44.	Huntington.....	Powder and dust explosion.	14
1903 Nov. 20.....	Bonanza No. 20.....	Bonanza.....	Gas explosion.....	11

of 2.42 per 1,000 men employed. The production per fatality was 180,117 tons, or there were 5.55 fatalities per million tons mined. There have been two serious mine explosions since 1897, in which 25 men were killed.

The 8-hour day prevails in Arkansas and the actual number of hours worked per man a year is 1,314 (Table 40), as compared with 2,255 hours for Alabama and 1,539 hours for Missouri. A fatality rate for the 10-year period, 1903 to 1913 (except 1909), for which

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **ARKANSAS**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Number of men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	38	4,029			2	14	114	4,157
1904.....	42	4,472					108	4,580
1905.....	45	4,146	1	16			30	4,192
1906.....	55	4,282					16	4,298
1907.....	67	4,970					115	5,085
1908.....	67	5,325					12	5,337
1909 <sup>b</sup> .....								5,266
1910.....	63	5,312					256	5,568
1911.....	53	5,196					142	5,338
1912.....	46	4,196					340	4,536
1913.....	53	4,652						4,652

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN ARKANSAS AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	223	33,398	7,447,754	3,724	.....	.....
1904.....	165	36,748	6,063,420	3,032	.....	.....
1905.....	177	33,582	5,944,014	2,972	8	2.69
1906.....	165	34,400	5,676,000	2,838	13	4.58
1907.....	190	40,795	7,751,050	3,876	13	3.35
1908.....	145	42,708	6,192,660	3,096	14	4.52
1909.....	.....	.....	.....	.....	.....	.....
1910.....	128	44,800	5,734,400	2,867	14	4.88
1911.....	133	42,846	5,698,518	2,849	12	4.21
1912.....	157	36,628	5,750,596	2,875	6	2.09
1913.....	174	37,216	6,475,584	3,238	12	3.71

complete data are available, is 2.36 per 1,000 men employed. This, however, reduced to a common basis of 2,000-hour workers, shows a rate of 3.74 per 1,000. Table 41 shows the other States worked out on a similar basis, so that comparisons may be readily made. The tables of statistics for the State follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN ARKANSAS.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	2,041	216,265	106	1907.....	1,185	35,835	30
1900.....	47	5,040	107	1908.....	4,037	387,841	96
1901.....	.....	.....	.....	1909.....	1,443	41,836	29
1902.....	14	140	10	1910.....	4,873	713,210	146
1903.....	398	2,078	5	1911.....	665	4,615	7
1904.....	76	1,424	19	1912.....	403	37,685	94
1905.....	625	7,806	12	1913.....	1,221	32,481	27
1906.....	3,828	291,095	76	1914.....	1,415	159,854	113

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





1910.....	1,405,938	1,568	5,568	14	2.51	7.35	136,140	128	342	2.47	7	6	6	12	63
1911.....	2,106,789	1,611	5,338	12	2.25	5.70	175,666	133	395	2.97	1.3	90.4	2	2	59
1912.....	2,100,819	1,711	4,536	6	1.52	2.89	350,137	157	463	2.95	3.7	92.2	6	3	55
1913.....	2,234,107	1,761	4,652	12	2.58	5.37	186,176	174	480	2.76	11.2	79.5	4	27	53
Total.....	36,559,588			171											
Average (1905-1913).....	2,141,396		4,919	11.89	2.42	5.55	180,117	157	435	2.77					
1914.....	1,836,540	1,72	4,339	11	2.54	5.99	166,968	143	423	2.96	19.1	77.9	1	28	56

*b* Not reported.

*a* Reports either not published or not available.

TABLE 88.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN ARKANSAS, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1897 TO 1914, INCLUSIVE.<sup>a</sup>

Year.	Killed underground.										Killed in shaft.					Killed on surface.					Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).		Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.
1897.....	1	1	1		14								17			1			1						
1898.....	3		1										4												
1899.....																									
1900.....												18													
1901.....											13														
1902.....																									
1903.....				11									11												
1904.....												2													
1905.....	5					1						3													
1906.....	7					4						3													
1907.....	9					2						4													
1908.....	8					1						5													
1909.....	9					2						4													
1910.....	10					4							14												
1911.....	9		1								1		11						1						
1912.....	5												5						1						
1913.....	5	1	1		2	1					1		11						1		1				
1914.....	3		3	2	1	1							10										1		

<sup>a</sup> Figures in italics represent incomplete fatality records.<sup>b</sup> Reports either not published or not available.

**CALIFORNIA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The area and distribution of the coal fields of California are described by Parker<sup>a</sup> as follows:

There are in California a number of small, widely separated coal fields, chief among them the Mount Diablo field of Contra Costa County, the Corral Hollow field of Alameda County, a small area in Amador County, the Priest Valley and Trafton fields of San Benito County, and the Stone Canyon field of Monterey County. The first two, which are on the eastern border of San Francisco Bay, and consequently in the west-central part of the State, produce black lignite or subbituminous coal. The areas in Monterey County are more to the south and in or near a region which has been considerably distorted. The coals are of the same geologic age as those farther north, but they have been altered into true bituminous coals. The alteration in the San Benito County area has not progressed so far as in the case of the Monterey County coals, but they closely approach the bituminous grade. None of them possess coking qualities.

The records of the State Mining Bureau of California show a production of coal in that State as early as 1861. It was at that time one of the 16 coal-producing States, and, relatively, of some importance as a coal producer. During the latter part of that decade and throughout the following decade the coal production of California exceeded 100,000 tons annually and reached a maximum of 236,950 tons in 1880. Since 1881 the production has been irregular, having been influenced chiefly, up to the beginning of the present century, by the imports of Australian and British Columbian coals, the receipts of Australian coals depending principally upon the wheat production and shipments from the Pacific coast. Since 1900, with the great increase in the production and use of petroleum which began in that year, coal production in California has fallen to an insignificant quantity.

**ACCIDENTS.**

Tables 89 and 90 show the production of coal and the number of men employed since 1889, for which reasonably complete records are available. Records of fatalities, however, date back only to 1909. In 1876 there was one explosion at Nortonville, in which six men were killed, and in 1909 there was another at Chancellor, which also killed

**COAL-MINE ACCIDENTS IN CALIFORNIA IN WHICH FIVE OR MORE MEN WERE KILLED.**

Date.	Name of mine.	Location of mine.	Nature of accident.	Number of men killed.
1876 July 24.....	Black Diamond.....	Nortonville.....	Mine explosion.....	6
1909 Jan. 19.....	Stone Canyon.....	Chancellor.....	.....do.....	6

six men. As is shown by the table following, the coal-mining industry of California is small, hence little attention has been given to the collection of accident and labor records. With the passage of the compensation laws no doubt more complete records will be available in the future. The tables of statistics for the State follow:

<sup>a</sup> Parker, E. W., The production of coal: Mineral Resources of the United States for 1913, U. S. Geol. Survey, 1914, pp. 819-820.



TABLE 89.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN CALIFORNIA, BY CALENDAR YEARS; ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.<sup>a</sup>

[Figures compiled from Mineral Resources, U. S. Geol. Survey, except figures in column 4, which were reported direct to the Bureau of Mines by the operators. Figures in columns 9 and 10 calculated.]



## COLORADO.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal fields of Colorado comprise an area of about 19,700 square miles, but in 3,800 square miles of this territory the coal beds may be 3,000 feet or more below the surface.

The fields may be grouped geographically into three groups, known as the Eastern, Park, and Western groups. The fields of each group occupy more or less irregular synclinal basins along the foothills, and on the sides nearer the mountains the rocks are more or less upturned and disturbed.

The Eastern group includes the Trinidad, Canon City, and Boulder coal fields, which yield about two-thirds of the coal now mined in Colorado. The Park group includes the fields in the South, Middle, and North Parks in the north-central part of the State, and is not extensively developed.

The Western group is the largest in area. It includes the Yampa field in the northern part of the State, and, to the south of the Yampa, the Danforth Hills, White River, Grand Hogback, Glenwood Springs, Crested Butte, Grand Mesa, Book Cliffs, and Durango fields, the Durango being in the extreme southwestern part of the State. About one-third of Colorado's coal is produced in this group of fields.

### CHARACTER OF COAL BEDS.

In the Trinidad field the coal beds are the same as those of the Raton field in New Mexico and range from  $3\frac{1}{2}$  to 9 feet in thickness. In some sections as many as 7 workable beds have been discovered, all of which are contained in the lower 900-foot level of the Vermejo (formerly called Laramie) formation. In the southern part of the field the measures lie nearly horizontal, but to the north the inclination increases slightly, varying from  $3^{\circ}$  to  $10^{\circ}$ . The Trinidad field contains a large amount of coking coal and manufactures about 600,000 tons of coke annually. In some mines in the vicinity of Starkville a thick sandstone forms a good roof; in other mines there is a "draw slate" between the coal and sandstone, making a poor roof. In the vicinity of Gray Creek the coal bed is almost level and is rather irregular, ranging from 4 to 14 feet thick.

The second field, as regards production, is the Boulder field, north of Denver. There the coal is much softer than that of the Trinidad field, being classed as subbituminous (black lignite). The associated rocks are also softer, rendering mining more difficult than it is where the rocks are harder and form a better roof. The coal beds range in thickness from 3 to 14 feet and generally are flat-lying, except near the west edge of the basin, where the coal and also the adjacent sandstone and shale beds dip strongly to the east.



In the Canon City field the rocks throughout most of the field dip west about  $2^{\circ}$  to  $5^{\circ}$ . Along the western margin of the strata is a thrust fault cutting across the coal measures, and near this fault the beds are sharply upturned, in some instances being practically vertical. The coal beds range in thickness from  $2\frac{1}{2}$  to 6 feet and generally are free from partings.

#### MINING METHODS.

The production of coal in Colorado dates back to 1864, when about 500 tons was mined. The production for 1913 was 9,232,510 tons. The total production for the State up to the end of 1913 is 175,361,698 tons. In 1911, of 140 of the principal mines 41 were shaft and 99 were slope and drift mines. In Las Animas County, which is the largest producer, over 40 mines are slope mines; only one or two are shaft mines. The room-and-pillar system of mining prevails largely throughout the State.

In the Canon City district, the long-wall system has been used to some extent in coal beds that vary from 3 to 4 feet thick and are tapped by shafts 300 to 400 feet deep. At the Radiant mine, where the coal bed is 3 feet to 3 feet 9 inches thick, a combination of the room-and-pillar and the long-wall methods is used, and the coal is undercut by electric machines. The coal is jointed and breaks into large lumps. At the Diamond mine, in the vicinity of Canon City, the coal beds dip  $55^{\circ}$  to  $75^{\circ}$ . At the Royal Gorge mine the dip is about  $50^{\circ}$  and the two coal beds mined are separated 5 feet to 7 feet. The lower bed is mined first by upward stoping from a horizontal level. The Littell mine is opened by a shaft 1,065 feet deep (1908), which is the deepest coal shaft in the State. The coal at this point dips about  $5^{\circ}$  to the west and is  $5\frac{1}{2}$  feet thick.

Coal-mining machines have been in use in Colorado since about 1891, at which time 20 machines were in operation. This number has gradually increased until in 1914 there were 306 machines in use, producing 25 per cent of the coal.

Shooting off the solid is practiced less in Colorado than in many other States, the coal thus mined in Colorado being 11 to 14 per cent of the total coal produced. About 60 per cent of the coal is produced by hand mining methods. The amount of coal mined per man per year in 1887 was 333 tons; in 1913 it was 770 tons.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The Legislature of Colorado, by an act approved February 24, 1883, provided for the appointment of an examining board, to examine applicants for the position of State inspector of mines. From the

list of eligibles thus established the governor was authorized to appoint a mine inspector for a term of four years. Section 12 provided that the act should apply to any coal mine where more than 12 men were employed underground. The inspector was required to examine at least once each quarter every mine employing more than 20 men, to make a record of such inspection, showing the number of employees, and number of accidents and deaths, and to file a report in the office of the secretary of state on the first Monday in November preceding the biennial sessions of the legislature. This report was included in the biennial report of the secretary of state.

All accidents causing loss of life or serious personal injury were reported by the operators to the inspector. An act of April 8, 1885, extended the inspection law to cover all mines employing more than 10 men, and required the inspector to examine such mines quarterly. On April 2, 1887, a law was approved directing the inspector to render a biennial report to the governor showing the number of persons employed and the number of accidents and deaths from injuries in and about the mines; the inspector was also authorized to employ clerical or other assistance not to exceed \$1,500 per year.

An act approved April 4, 1913, authorized the governor to appoint a chief mine inspector and the chief thus selected to appoint five deputy inspectors. The chief and deputy inspectors are selected from a list of eligibles established by a board of examiners. The chief mine inspector divided the State into five districts and assigned one deputy inspector to each district. An annual report for the year ending December 31 is rendered to the governor, the report to enumerate all deaths and accidents causing disability for 5 days or more. Operators are required to render monthly reports of fatal and nonfatal accidents to the inspector, in addition to sending to the chief inspector immediate notice of all fatal accidents.

Accidents resulting in 5 or more days' disability, which under the law are reported to the inspector by mine operators, are published in the inspector's annual reports and are classified as serious or slight according to the judgment of the State mine inspector.

In 1915 the inspector was assisted by four deputies.

#### ACCIDENTS.

Tables 91 and 92 show the total number of fatalities by causes and calendar years since 1883 as compiled from State mine inspectors' reports. The accompanying tables show the percentage of accidents, classified by principal causes, and fatality rate per 1,000 men employed, over a period of 28 years, 1886-1913, for which continuous records are available. The fatality rate during this period is 7.14 per 1,000 men

FATALITIES IN **COLORADO** COAL MINES BY PRINCIPAL CAUSES DURING 1886 TO 1913, INCLUSIVE.

Causes.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.)	852	49.02	3.50
Mine cars and locomotives	141	8.11	.58
Gas and dust explosions	517	29.75	2.12
Explosives	60	3.45	.25
Miscellaneous	83	4.78	.34
Shaft	36	2.07	.15
Surface	49	2.82	.20
Total (28 years)	1,738	100.00	7.14

COAL-MINE ACCIDENTS IN **COLORADO** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1884 Jan. 24.	Crested Butte.	Crested Butte.	Mine explosion.	59
1889 Sept. 9.	White Ash.	Jefferson County.	Inrush of water from old shaft.	10
1893 Jan. 10.	Como.	King.	Mine explosion.	24
1896 Feb. 18.	Vulean.	New Castle.	do.	49
1897 Sept. 3.	Sunshine.	Sunshine.	do.	12
1901 Sept. 16.	Spring Gulch.	Spring Gulch.	do.	6
1902 Aug. 7.	Bowen.	Bowen.	Powder and mine explosion.	13
1904 Oct. 28.	Tercio.	Tercio.	Mine explosion.	19
1906 Feb. 19.	Maitland.	Walsenburg.	do.	14
1906 Apr. 22.	Cuatro.	Tercio.	do.	19
1907 Jan. 23.	Primero.	Primero.	do.	24
1907 May 19.	Engleville.	Engleville.	Mine fire.	5
1909 July 6.	Toller.	Tollerville.	Mine explosion.	9
1910 Jan. 31.	Primero.	Primero.	do.	75
1910 Oct. 8.	Starkville.	Starkville.	do.	56
1910 Nov. 8.	Victor American No. 3.	Delagua.	Mine fire and explosion.	79
1910 Dec. 14.	Leyden.	Leyden.	Mine fire.	10
1911 Feb. 9.	Cokedale.	Trinidad.	Mine explosion.	17
1912 June 18.	Hastings.	Hastings.	do.	12
1913 Dec. 16.	Vulean.	New Castle.	do.	37

employed. There were 19 accidents in which 5 or more men were killed at one time, representing slightly over 28 per cent of all of the fatalities due to mine accidents. Of the total number of fatalities 49.02 per cent were due to falls of roof and pillar and 29.75 per cent to gas and dust explosions. The average production of coal per fatality during this period was 96,798 tons, or there were 10.33 fatalities for each million tons mined.

Beginning with 1903 and including 1912 about 50 per cent of the men were on a 10-hour basis. In 1913 the 8-hour law became effective and only a few men were employed for a longer day than eight hours. The time element has been taken into consideration and tables compiled on this basis for comparison with other States. The fatality rate for the 10-year period, 1903-1913 (Table 40), based on the actual



# 160 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

NUMBER OF HOURS TO THE WORKING-DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **COLORADO**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Number of men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	24	488	17	692	70	7,743	306	9,229
1904.....	55	2,058	11	432	57	5,583	50	8,123
1905.....	61	3,660	4	189	40	6,551	620	11,020
1906.....	67	5,259	9	655	48	5,222	232	11,368
1907.....	60	3,420	8	312	54	7,439	3,052	14,223
1908.....	79	5,158	3	63	61	8,535	767	14,523
1909 <sup>b</sup> .....								11,472
1910.....	61	2,935	8	303	49	5,913	6,713	15,864
1911.....	57	2,701	10	299	46	4,559	6,814	14,373
1912.....	61	2,923	5	173	50	4,631	5,273	13,000
1913.....	146	11,175	3	75	5	128	612	11,990

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **COLORADO**, AND THE FATALITY RATE, BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	245	90,316	22,127,420	11,064	44	3.98
1904.....	261	76,632	20,000,952	10,000	94	9.40
1905.....	255	102,071	26,028,105	13,014	65	4.99
1906.....	268	102,275	27,409,700	13,705	89	6.49
1907.....	258	132,026	34,052,708	17,031	107	6.28
1908.....	212	134,084	28,425,808	14,213	63	4.43
1909.....						
1910.....	236	145,754	34,397,944	17,199	323	18.78
1911.....	207	131,215	27,161,505	13,581	88	6.48
1912.....	227	118,708	26,946,716	13,473	96	7.13
1913.....	229	96,863	22,181,627	11,091	108	9.74

number of employees is 8.71, whereas on the number of 2,000-hour workers it is 8.02 per 1,000. During the 10-year period the men averaged 2,172 hours employment per year. Table 41 shows the fatality rate for each year on the 2,000-hour basis, 1903-1913, for each State, so that a true comparison of Colorado with other States may be readily made.

The tables of statistics for the State follow.

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN COLORADO.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	504	31,520	62	1907.....	215	6,378	30
1900.....	17	935	55	1908.....	768	16,646	22
1901.....	1,527	86,045	56	1909.....	55	1,250	23
1902.....	444	20,845	47	1910.....	2,044	195,558	96
1903.....	7,103	407,909	57	1911.....	450	32,375	216
1904.....	3,865	481,482	125	1912.....			
1905.....				1913.....	7,324	552,082	75
1906.....				1914.....	4,418	1,090,025	247

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





1907.....	10,780,236	1.40	14,223	107	7.52	9.92	100,843	258	759	2.94	15.7	103	58	14	175
1908.....	9,634,973	1.41	14,223	63	4.34	6.54	152,936	212	663	3.13	17.3	137	56	18	211
1909.....	10,716,936	1.33	11,472	97	8.46	9.05	110,484	(a)	934	(a)	18.0	175	66	12	223
1910.....	11,973,736	1.42	15,804	323	20.36	26.98	37,070	236	755	3.20	16.0	182	55	19	296
1911.....	10,157,383	1.45	14,373	88	6.12	8.66	115,425	207	707	3.42	19.5	157	26	34	242
1912.....	10,977,824	1.49	13,000	96	7.38	8.74	114,352	227	844	3.72	23.2	187	33	16	304
1913.....	9,252,510	1.52	11,990	108	9.01	11.70	85,486	229	770	3.36	25.0	168	35	12	399
Total.....	175,361,698			1,817											
Average (1886-1913).....	6,008,413		8,693	62.07	7.14	10.33	96,798	230	691	3.00					
1914.....	8,170,559	1.66	10,098	75	7.43	9.18	108,941	244	809	3.32	57.3	168	35	11	396
											30.6	11.6		57	5
															193

a Not reported.

TABLE 92.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN **COLORADO**, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1883 TO 1914, INCLUSIVE.

Year.	Killed underground.											Killed in shaft.					Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	(Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	(Cages or skips.	(Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	(Other causes.	Total.
1883 <sup>a</sup>	4		1	59									64						1							64
1884	1	1	3	1									8													9
1885	4		3										8													9
1886	3												5													6
1887	9												11	1					1							12
1888	12	1	4	5	3	2							29													29
1889	5	4	3										23													24
1890	6	4	1	1									11	2					1							16
1891	17	5	2		2								30	1												30
1892	11	10	2	2	b 24	3							44	1	1	2			4							46
1893	13	3	3	1		1							17	1				1	1							19
1894	11	2	1	1		2							21	1				2	1							23
1895	16	2	2	4									36						1							36
1896	14	2	2		49								68						1							68
1897	15	4	3		12								36						1							36
1898	13	3	3										20						1							23
1899	28	6	2										38						1							38
1900	19	6	3										29						1							31
1901	25	5	2		8				1	1	1	2	52						1							55
1902	37	5	3	2									71						1							73
1903	26	4	2	8	14	3							40						1							44
1904	43	10	10		19	4							89						1							94
1905	35	4	8										57						1							65
1906	37	9	2	34									85						1							89
1907	51	7	9		25	4							100						1							107
1908	33	5	9	12									59						1							63
1909	56	7	9	15									89						1							97
1910	62	11	18	79	131	5					10	2	318	2	1	2			1							323





## GEORGIA.

### AREA AND DISTRIBUTION OF COAL FIELDS.

Parker <sup>a</sup> describes the coal-productive area of Georgia as follows

The coal-productive area of Georgia underlies portions of two counties in the extreme northwestern corner of the State. The Walden Basin of Tennessee crosses Dade County, in Georgia, and extending southwesterly becomes the Blount Mountain and Warrior Basins in Alabama. The Lookout Basin, a narrow outlying area, extends from Etowah County, in Alabama, in a northeasterly direction into Walker County, Ga. The total area of the coal fields in Georgia is estimated at 167 square miles the smallest coal area of any Appalachian State. Not all of the field is workable. Extensive operations have been carried on in both counties, however, but all of the production in 1913 was by two companies operating in Walker County. On account of its high percentage (80 per cent) of fixed carbon and its low sulphur content, the Lookout Mountain coal (Walker County) gives a large product of excellent coke which is sold to the furnaces of Chattanooga and of other points in Tennessee and in Georgia.

The earliest report by the United States Geological Survey on the production of coal in Georgia is for 1860, when 1,900 tons were mined. The production gradually increased to its highest point in 1903, when 416,951 tons were produced, and since then has gradually declined to approximately 200,000 in recent years. No mining machines are used in the coal mines of Georgia. The reports of the United States Geological Survey show that all of the coal in 1913 <sup>b</sup> was shot off the solid. Of the total production, approximately one-third of the coal is washed.

### ACCIDENTS.

Tables 93 and 94 show the total number of fatalities by causes and calendar years since 1909. They also show the percentage of accidents and fatality rate per 1,000 men employed. The average production of coal per fatality during this period was 148,111 tons, or there were 6.75 fatalities per million tons mined.

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<sup>a</sup> Parker, E. W., Production of Coal, Mineral Resources of the United States for 1913, U. S. Geol. Survey, 1914, p. 825.

<sup>b</sup> Parker, E. W., *op cit.*, p. 825.

FATALITIES IN **GEORGIA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS  
1909 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 em- ployed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	6	85.71	2.60
Mine cars and locomotives.....			
Gas and dust explosions.....			
Explosives.....	1	14.29	.43
Miscellaneous.....			
Shaft.....			
Surface.....			
Total (5 years).....	7	100.00	3.03

There is no mine inspection in the State. The tables of statistics for the State follow:





1912.....	227,502	1.49	450	2	4.44	8.79	113,752	254	593	1.99	65.0	35.0	2
1913.....	255,626	1.41	500	3	6.00	11.74	85,269	261	511	1.96	100.0	100.0	2
Total.....	9,425,298			7									
Average (1909-1913).....	207,356		461	1.40	3.03	6.75	148,111	265	450	1.70			
1914.....	166,498	1.44	355	1	2.82	6.01	166,498	207	469	2.27	100.0	100.0	2

<sup>a</sup> Not reported.

TABLE 94.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN GEORGIA,<sup>a</sup> WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1909 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	(Jacks or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1909.	1	2	3	4	5	6	7	8	9	10	11	12			13	14	15	16		17	18	19	20	21	22	
1910.	2																									
1911.	1					1																				
1912.	3																									
1913.	1																									
1914.	1																									

<sup>a</sup> Figures for 1909 are from Mineral Resources, U. S. Geol. Survey; others from reports of mine operators as received by the Bureau of Mines.

**ILLINOIS.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The Illinois coal field is the western part of a broad and relatively flat basin which extends eastward into Indiana and southeastward into Kentucky. On the southwestern border of the field the coal beds are turned up perceptibly, and on the south the margin is marked by a much steeper fold, which is overturned and faulted near Shawneetown where it crosses Ohio River. On the north border the coal beds are bent into a low, though sharply defined anticline which extends from La Salle southeastward toward Clark County. Minor folds, local in extent, occur in different parts of the basin, but in general the beds dip gently from the margins of the field to a central deep area where the coal-bearing rocks have a thickness of about 1,500 feet.

**CHARACTER OF COAL BEDS.**

There are in the Illinois field a number of coal beds of varying thickness, each of which, however, is fairly regular and continuous over large areas. The coal production of Illinois is from six beds, Nos. 1 to 3 and 5 to 7. No. 6 is the most important and averages 6 feet thick. This bed produces over 50 per cent of the coal; No. 5 produces 25 per cent; and No. 2, 10 per cent.

The beds are practically horizontal and have been opened at different depths in the various counties. In Gallatin County two coal beds have been mined at depths of 60 and 180 feet, the upper being 5 feet thick and the lower 3 feet thick. In Macoupin County, near Virden, coal No. 5 is 7 feet 8 inches thick at a depth of 320 feet. In St. Clair County, near Belleville, coal No. 6 is 8 feet 4 inches thick at a depth of 380 feet. In Marion County, at Centralia, coal No. 6 is 7 feet thick at a depth of 569 feet and at Sandoval 6 feet thick at a depth of 603 feet. In Sangamon County the principal coal bed is 6 feet thick with a good limestone roof and is opened by shafts varying from 65 to 225 feet in depth. In Perry County the Belleville, or No. 6, coal bed is 5 to 6 feet thick at depths varying from 30 to 200 feet and dips slightly north. A shaft at Assumption, Christian County, is 1,003 feet deep, being the deepest in the State.

Illinois coal is bituminous, but has a moisture content as it comes from the mine of 7 to 16 per cent. The best coal contains 7 to 10 per cent of ash, one-half to 3 per cent of sulphur, and 40 to 50 per cent of fixed carbon.

**MINING METHODS.**

The record of coal-production for Illinois begins in 1833, during which year 6,000 tons were mined. The production for the State has gradually increased until in 1913 it amounted to 61,618,744 tons.

As in Indiana, the shaft mines largely predominate over slope and drift mines, which number less than 50. In 1897 only 52 out of 853 mines used the longwall method, and these were in the north-eastern part of the State in the No. 2 bed, where the coal is only 3 feet thick. In the other mines the room-and-pillar system of mining prevails with slight alterations for individual mines or different coal beds. In 1897 only one-half of the coal was undercut before blasting, leaving about 50 per cent as shot off the solid. In 1912, 40 per cent of the coal was shot off the solid, but in 1913 this was reduced to 32.3 per cent. In 1888 there were 272 mining machines in the mines, producing 18.9 per cent of the coal, and in 1913 there were 1,845 machines, which produced 53 per cent of the coal, or 17,685 tons per machine. The coal, being horizontal and uniform, is well adapted to machine mining.

Most of the mines are dry, and but little pumping is required. The deeper mines are drier than the shallow ones and require sprinkling to prevent accumulation of dust.

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The inspection of coal mines in Illinois was inaugurated by virtue of an act of the general assembly approved March 27, 1872, which became effective July 1, 1872. By section 11 of this act the county surveyors were constituted ex-officio inspectors of mines within their respective counties, each with authority to call to his aid a reputable practical miner. The act also provided that all accidents causing loss of life or serious personal injury at any coal mine or colliery should be reported to the county mine inspector, and that all fatal accidents should also be reported to the coroner of the county in which the accident occurred. It was made the duty of the inspector to investigate all accidents thus reported to him, and all expenses incident to his investigation were payable by the county in which the accidents occurred.

By an act approved June 18, 1883, effective July 1, 1883, the State was divided into five mining districts, and a State mine inspector for each district authorized. Each county was authorized to appoint an assistant mine inspector, if it so desired, such county inspector to perform his duties under the direction of the district mine inspector. The act directed that accidents should thereafter be reported to the district mine inspector instead of the county inspector, and that fatal accidents might be reported to a justice of the peace in the absence or inability to act of the county coroner.

Subsequent laws have made no change in the reportability of mine accidents as above set forth. There are now 12 inspection districts in the State.



## ACCIDENTS.

Tables Nos. 95 and 96 show the total number of fatalities by causes and calendar years since 1885, and the total production of coal. They also show the percentage of accidents, by principal causes, and fatality rate per 1,000 employed over a period of 29 years, for which continuous records are available. During this period there were 3,409

FATALITIES IN **ILLINOIS** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1885 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	1,616	47.40	1.19
Mine cars and locomotives.....	414	12.14	.30
Gas and dust explosions.....	170	4.99	.13
Explosives.....	459	13.47	.34
Miscellaneous.....	350	10.27	.26
Shaft.....	266	7.80	.20
Surface.....	134	3.93	.10
Total, 29 years.....	3,409	100.00	2.52

COAL-MINE ACCIDENTS IN **ILLINOIS** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1883 Jan. 9.....	Coulterville.....	Coulterville.....	Mine explosion.....	10
1883 Feb. 16.....	Diamond.....	Braidwood.....	Inrush of surface water into workings.	69
1903 Mar. 15.....	Cardiff.....	Cardiff.....	Mine explosion.....	5
1903 Mar. 23.....	Athens No. 2.....	Athens.....	Windy shot.....	6
1903 Mar. 31.....	Sandoval.....	Sandoval.....	Blown-out shot.....	8
1904 May 11.....	Big Muddy.....	Herrin.....	Powder explosion.....	10
1905 Jan. 16.....	Decatur.....	Decatur.....	Mine fire.....	6
1905 Apr. 3.....	Leiter.....	Zeigler.....	Mine explosion.....	49
1906 Dec. 22.....	Breese-Trenton.....	Breese.....	Cage with men fell down shaft.	6
1907 Jan. 29.....	Johnston City.....	Johnston City.....	Powder explosion.....	7
1909 Jan. 10.....	Zeigler.....	Zeigler.....	Mine fire and explosion	26
1909 Nov. 13.....	St. Paul No. 2.....	Cherry.....	Mine fire.....	259
1909 Dec. 23.....	Mine A.....	Herrin.....	Mine explosion.....	8
1910 Nov. 11.....	Shoal Creek No. 1.....	Panama.....	do.....	6
1911 Oct. 23.....	O'Gara No. 9.....	Harrisburg.....	do.....	8
1913 Feb. 19.....	Seagraves.....	Eldorado.....	do.....	5
1914 Oct. 27.....	North or No. 1.....	Royalton.....	do.....	52
1915 Apr. 5.....	Shoal Creek.....	Panama.....	do.....	11
1915 July 27.....	United Coal No. 1.....	Christopher.....	do.....	9

fatalities or 2.52 per 1,000 men employed. There were 14 accidents in which 5 or more men were killed at one time, representing about 12 per cent of the total fatalities. These large accidents include the mine fire at Cherry in which 259 men were killed at one time. The average production of coal per fatality during this period was 251,900 tons or 3.97 fatalities per million tons mined.

Practically all of the mines in Illinois are operated on an 8-hour basis so that a comparison with 10-hour States on the basis of days worked is not a proper method. The time element has therefore been taken into consideration and a table compiled on the basis of the actual number of hours worked so that a true comparison with other

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN ILLINOIS.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	542	47,773	11	57	9	45	2,721	50,596
1904.....	547	53,500	17	121	10	52	1,012	54,685
1905.....	583	56,206	8	64	6	405	1,288	58,053
1906.....	482	60,181	9	610	1	30	1,267	61,983
1907.....	457	60,268	8	675	1	4	4,634	65,581
1908.....	491	65,289	5	510			2,236	68,035
1909.....								69,425
1910.....	521	69,575		137	1		2,929	72,645
1911.....	513	75,088	7	68	2	10	490	75,656
1912.....	480	75,411	10	67			2,620	78,098
1913.....	482	78,137	7	41	1	5	1,346	79,529

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey. <sup>b</sup> Census year.

## NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN ILLINOIS AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day. (all employees.)	Total hours per year.	Number of 2,000 hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	228	407,636	92,941,008	46,471	158	3.40
1904.....	213	438,717	93,446,721	46,723	173	3.70
1905.....	201	466,586	93,783,786	46,892	203	4.33
1906.....	192	497,841	95,585,472	47,793	161	3.37
1907.....	218	529,965	115,532,370	57,766	192	3.32
1908.....	185	547,026	101,199,810	50,600	172	3.40
1909.....						
1910.....	160	584,234	93,477,440	46,739	143	3.06
1911.....	188	605,826	113,895,288	56,948	172	3.02
1912.....	194	627,471	121,729,374	60,865	163	2.68
1913.....	189	637,629	120,511,881	60,256	164	2.72

States may be made. The fatality rate for the 10-year period, 1903-1913 (Table 40), for Illinois on the 2,000-hour basis is 3.26 as compared with 2.55 based on the actual number of men employed. During the 10-year period, the men averaged 1,567 hours per year as compared with 2,132 hours in West Virginia.

The tables of statistics for the State of Illinois follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN ILLINOIS.<sup>a</sup>

Year.	Number of men affected.	Total number of days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total number of days lost.	Average number of days lost per man.
1899.....	7,133	267,171	37	1907.....	5,255	35,191	7
1900.....	3,909	134,433	34	1908.....	47,456	1,737,611	37
1901.....	3,740	79,245	21	1909.....	2,335	90,720	38
1902.....	3,916	65,231	17	1910.....	67,218	9,133,953	136
1903.....	3,772	70,731	19	1911.....	5,543	100,588	18
1904.....	16,983	156,528	9	1912.....	60,505	2,026,526	33
1905.....	15,289	321,967	21	1913.....	11,801	655,622	55
1906.....	49,792	2,900,525	58	1914.....	23,506	950,406	41

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 95.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN ILLINOIS, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES USED.

[Figures for total production and all items below horizontal line in various columns selected from Mineral Resources, U. S. Geol. Survey. All items in column 4 and others above horizontal lines in columns 2, 3, 8, 12, 20, and 21 from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10 prior to 1990, calculated.]



[illegible]

<sup>b</sup> July 1 to Dec. 31.

c Not reported.

c Not reported.

TABLE 96.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN ILLINOIS, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	(Gas explosions and burning gas.	Coal-dust explosions.	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.		
1882 a.....	3		2									29	39													1	40	
1883 a.....	40			10		5						84	134														134	
1884 a.....	29											17	46														46	
1884 (July 1 to Dec. 31).....	5	2	1			1	1						10	3	1	2	2	1	7			1	2				1	18
1885.....	25		5			8							39	3	1	4		4									5	50
1886.....	18		5			1							32	4	1	1		4									5	36
1887.....	25	9	7	1		8						1	43	4	1	3		1									4	51
1888.....	25	7	4			3							45	4	1	3											4	57
1889.....	22	5	5	2		7							37	4	2	6		4									5	41
1890.....	22	7	1			4							44	2	2	2		4									4	57
1891.....	22	8	1	3	3	4					3		41	2	1	4		4									5	69
1892.....	29	12	9	2		7					2		57	7	1	6		12									4	69
1893.....	42	9	5	2		14			1				64	7	1	2		14									5	83
1894.....	25	3	3	2		7							49	2	1	4		5									5	78
1895.....	32	11	4		1	11							59	5	1	8		14									5	83
1896.....	36	6	7			12							64	6	1			17									5	90
1897.....	33	11		5		15							76	4				10									5	90
1898.....	52	7	6			8	2						63	6				5									5	90
1899.....	32	7	7			15				2			91	3	2	4		8									5	102
1900.....	48	10	12			18			1				92	4	2	4		11									5	107
1901.....	52	8	12	1		19							95	3	2	5		10									4	107
1902.....	42	12	16			24							146	2	2	3		8									4	158
1903.....	68	12	20	10		40							186	11	1	6		17									4	173
1904.....	64	12	17			53		1					149	5	1	5		23									6	161
1905.....	66	15	19	31		25		2			6		186	10	2	6		11									6	203
1906.....	66	17	23	3	2	20							132	4	3	11		8									6	161
1907.....	73	20	39	5		31		2	1				174	6	4	1		8									10	192
1908.....	61	21	27	3		38		1		1			153	6	1	1		8									11	172

1909.....	53	22	20	45	34	.....	3	2	.....	259	2	440	.....	1	6	.....	7	.....	2	.....	1	5	3	11	458
1910.....	61	13	28	8	9	.....	1	5	.....	.....	.....	125	.....	4	6	.....	13	.....	.....	.....	3	1	6	143	
1911.....	66	17	41	9	15	.....	3	1	.....	.....	1	154	.....	3	7	.....	12	.....	1	1	3	1	5	172	
1912.....	65	19	41	3	11	.....	2	2	1	.....	.....	144	.....	1	5	.....	12	1	.....	.....	3	2	3	163	
1913.....	59	21	38	8	11	.....	8	1	.....	1	5	163	.....	1	1	.....	4	.....	1	1	3	7	7	164	
1914.....	49	20	38	55	9	.....	2	.....	.....	2	1	176	.....	2	1	.....	8	.....	2	.....	3	3	9	193	

<sup>a</sup> Fiscal year ending June 30. "Other Causes" doubtless include fatalities belonging under other headings, but no information is available for a more detailed classification. The 84 fatalities under "Other Causes" in 1883 include 69 deaths due to rush of water at the Diamond mine, Bradwood, Ill., Feb. 16, 1883.



## INDIANA.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal-bearing area of Indiana amounts to about 6,500 square miles and includes 26 counties in the southwestern portion of the State. Nineteen of these counties are producing coal on a commercial scale. The coal measures contain over 20 horizons, in which coal beds of varying thickness have been found. Of these eight are of workable thickness over much or all of the field and several others are locally of workable thickness. In the center of the field as many as seven or eight beds are workable in a single area. Ordinarily over most of the field not more than three workable beds will be found.

The coal measures in Indiana have a total thickness of approximately 1,300 feet. Of these 1,300 feet there are 600 feet of barren beds at the top, a 500-foot interval which contains most of the workable coals, followed in descending order by 200 feet or more of rocks consisting mainly of sandstone.

### CHARACTER OF COAL BEDS.

The eight different coal beds mined vary from 3 to 9 feet in thickness. The coal in the eastern part of the field is called block coal or semiblock because of its breaking into rectangular blocks. It is very pure, noncoking coal. The strictly "block coal" is found in Fontaine, Parke, Clay, and Owen Counties. South of that the coals in the easternmost counties are semiblock. The block coal occurs in small basins which vary in extent from a few acres to several square miles, owing to the irregular surface of the rocks upon which they were laid down. The coal may be 3 to 5 feet thick in the center of a basin but thins out gradually toward the edges. The western counties of the Indiana field contain bituminous coal. The bituminous beds vary from 3 to 10 feet in thickness, most of the workings being in beds over 5 feet thick. In 1910, 26 mines were mining coal from beds over 7 feet thick. These coals lie regularly with a slight pitch to the west and southwest, and in many parts of the field are regular in thickness. Practically all of the mines have a clay floor and shale roof. The No. 5 coal is overlain with black shale, commonly broken with pyrite concretions, that locally will hold up indefinitely over a 40-foot room without any posts. Most of the beds, however, have roofs of shale that tends to disintegrate rapidly in the summertime, especially in the air passages, and requires close posting.

### MINING METHODS.

The earliest records of coal production in Indiana are for 1840, when 9,682 tons were mined. The production increased gradually until in 1913 it was 17,165,671 tons.

Most of the commercial mines are opened by shafts varying from 50 to 450 feet deep, only a few being opened by slopes and drifts. From the shafts the mines are opened by main entry and air course, each 8 feet wide, separated by a 12-foot pillar. The coal is mined almost exclusively by the room-and-pillar method, which varies in detail in different districts and even in different coal beds of the same district. The mines are usually well equipped with the latest appliances, including electric machines and self-dumping cages.

Mining machines were first used in 1884. The "block coal" was first successfully mined by machines in 1894. In 1891 there were 47 mining machines in operation and in 1913 there were 732 which produced 56.7 per cent of the coal mined during the year. Of the total number of machines used 365 were of the chain-breast type. The average production per machine in 1913 was 13,302 tons.

About 30 per cent of the coal mined is shot off the solid; hand mining produced only about 11 per cent of the total output in 1913.

### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

An act approved March 8, 1879, which became effective May 1, 1879, authorized the governor to appoint a mine inspector, whose duty was to inspect each coal mine in the State at least twice a year. The inspector was required to render annual reports to the governor and to state therein the number of mines operating, the production of each mine, and such other information as the inspector deemed necessary. On February 26, 1889, the department of geology and natural science was created and placed under the supervision of a director, who was also the State geologist. The department consisted of four divisions: Geology and natural science, mines and mining, mineral oils, and natural gas. The chief of each division was appointed by the geologist. The office of mine inspector was abolished, and the chief of the division of mines and mining, to be known as the inspector of mines, was directed to perform all duties previously performed by the mine inspector. Annual reports of the inspector were included in the annual reports of the department. The inspector was authorized to employ one assistant.

An act approved March 2, 1891, covering coal mines employing 10 or more men, made it the duty of mine operators to report, under penalty, all mine accidents causing death, and upon receipt of such a

notice the inspector and coroner were required to investigate the cause of the accident. The act of March 4, 1891, restricted the appointment of inspector of mines to persons who had passed an examination satisfactory to the State geologist. On March 6, 1897, an act was approved directing mine operators to report to the inspector all accidents which prevented the usual working of a mine for 24 consecutive hours, or resulted in injuries causing death or requiring the attendance of a physician or surgeon. On March 11, 1901, the number of assistants to the inspector was increased to two, and on March 9, 1907, the number was further increased to four. The latter act also required that each mine should be inspected at least three times each year.

An act approved March 6, 1911, created a bureau of inspection, to consist of three departments: Inspection of mines, inspection of boilers, and inspection of factories. The new bureau was placed under the supervision of a chief inspector appointed by the governor. The governor also appointed three deputies, one for each of the departments comprising the bureau. Each deputy inspector was authorized to appoint five assistants, with the approval of the chief inspector.

Up to 1915 it was the practice of operators of mines employing 10 or more men to report to the inspector all accidents causing death or requiring the attendance of a physician or surgeon, and all such accidents were published in the inspector's annual reports. Injuries causing disability for two weeks were classified as serious, all others being considered slight.

The legislature of 1915 passed a workmen's compensation act, effective September 1, 1915, to be administered by the Industrial Board of Indiana, which was also provided for by the act. The department of inspection of mines and mining was transferred to the industrial board. Under the compensation law all employers of labor are required under penalty to report to the board all accidents causing injury to an employee whereby the employee is incapacitated for work more than one day. The department of mines, under the jurisdiction of the industrial board, consists of one chief inspector and five assistants, who are appointed by the board with the concurrence of the governor.



## ACCIDENTS.

The accompanying tables show the total number of fatalities by causes and calendar years since 1881 as compiled from State mine inspectors' reports. They also show the percentage of accidents, by principal causes, and the fatality rate per 1,000 men employed for a period of 19 years for which continuous records are available. The fatality rate during this period is 2.16 per 1,000 men employed.

FATALITIES IN **INDIANA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1895 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	306	45.07	0.97
Mine cars and locomotives.....	75	11.04	.24
Gas and dust explosions.....	57	8.39	.18
Explosives.....	132	19.44	.42
Miscellaneous.....	22	3.24	.07
Shaft.....	71	10.46	.23
Surface.....	16	2.36	.05
Total, 19 years.....	679	100.00	2.16

COAL-MINE ACCIDENTS IN **INDIANA** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1878 Nov. 21.....	Sullivan.....	Sullivan.....	Mine explosion.....	8
1896 Dec. 26.....	Oswald.....	Princeton.....	do.....	7
1905 Mar. 22.....	do.....	do.....	Powder and mine explosion.....	9
1907 Jan. 14.....	Deering No. 7.....	Clinton.....	Powder explosion.....	7
1909 Mar. 20.....	Sunnyside.....	Evansville.....	Mine explosion.....	6

Indiana has been fortunate in that it has had but few disasters (only four) during this period in which 5 or more men were killed at one time, the total number being 29 fatalities, or slightly over 4 per cent of the entire number. To offset this, however, there were 132 fatalities due to explosives, representing 19.44 per cent of the total. The average production of coal per fatality during this period was 291,062 tons, or 3.44 fatalities per million tons mined.

Indiana, like Illinois, is an 8-hour State, and in order to make it comparable with other States, where 9 or 10 hours are considered a working day, a table has been compiled whereby the time element has been taken into consideration. The fatality rate for the 10-year period 1903-1913 (Table 40) based on the actual number of employees

# 182 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **INDIANA.**<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	236	16,291	5	24	6	39	663	17,017
1904.....	244	18,727	7	44	4	16	800	19,587
1905.....	271	24,484	2	24	3	15	800	25,323
1906.....	230	19,842	2	100			1,028	20,970
1907.....	208	18,323					2,699	21,022
1908.....	207	18,040			1	5	335	18,380
1909 <sup>b</sup> .....								20,937
1910.....	215	20,783	4	16	3	14	1,065	21,878
1911.....	213	20,946	2	7	3	16	22	20,991
1912.....	211	21,220	1	6	5	109	316	21,651
1913.....	199	21,637	3	42	6	121	435	22,235

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **INDIANA,** AND THE FATALITY RATE, BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	197	136,901	26,969,497	13,485	52	3.86
1904.....	177	157,572	27,890,244	13,945	34	2.44
1905.....	151	203,438	30,719,138	15,360	46	2.99
1906.....	175	168,888	29,555,400	14,778	31	2.10
1907.....	197	170,875	33,662,375	16,831	53	3.15
1908.....	174	147,385	25,644,990	12,822	45	3.51
1909.....					49	
1910.....	229	176,133	40,334,457	20,167	51	2.53
1911.....	182	167,989	30,573,998	15,287	46	3.01
1912.....	182	173,748	31,622,136	15,811	35	2.21
1913.....	190	178,599	33,933,810	16,967	66	3.89
1914.....						

is 2.20 as compared with 2.95 on the 2,000-hour basis. Table 40 gives all of the States on this basis for the 10-year period, so that a comparison with other States may be made. During this period the men worked 1,487 hours per year as compared with 2,034 hours for the bituminous fields of Pennsylvania.

The tables of statistics for the State of Indiana follow.

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN INDIANA.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	3,272	132,825	40	1907.....	3,176	42,842	13
1900.....	3,583	71,282	20	1908.....	7,076	157,899	22
1901.....	1,027	40,812	39	1909.....	36	720	20
1902.....	1,824	23,693	13	1910.....	12,638	423,894	34
1903.....	2,680	46,560	17	1911.....	4,577	146,636	32
1904.....	1,061	22,963	18	1912.....	15,400	795,887	52
1905.....	981	12,528	13	1913.....	2,657	44,143	17
1906.....	15,875	995,217	63	1914.....	8,052	302,855	38

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.
	10,794,632	10,842,189	11,895,252	12,062,560	13,985,713	12,314,890	14,834,259	18,389,815	14,201,355	15,285,718	17,165,671	251,632,098
	1.23	1.11	1.05	1.08	1.08	1.06	1.02	1.13	1.08	1.14	1.11	1.10
	17,017	19,587	25,323	20,970	21,022	18,380	20,937	21,878	20,991	21,651	22,235	16,581
	52	34	46	31	53	45	49	51	46	35	66	35.74
	3.06	1.74	1.82	1.48	2.52	2.45	2.34	2.33	2.19	1.62	2.97	2.16
	4.82	3.14	3.87	2.56	3.79	3.65	3.30	2.77	3.24	2.29	3.84	3.44
	207,500	318,888	258,592	390,083	263,881	275,664	302,740	390,585	308,725	436,735	260,086	291,062
	634	554	470	577	665	670	709	841	677	708	772	627
	3.22	3.13	3.11	3.10	3.38	3.85	(b)	3.67	3.72	3.88	4.06	3.35
	30.9	33.3	35.4	35.2	38.0	43.0	50.0	48.9	49.6	54.7	56.7	56.2
	110	139	142	124	147	140	227	194	168	198	166	176
	219	269	362	329	308	332	391	422	426	348	365	391
	1	2	18	58	35	35	13	29	30	99	105	69
	329	409	506	471	513	507	631	645	667	687	732	751
	184	210	208	200	204	204	206	251	257	238	231	225
Total.	251,632,098											
Average (1895-1913).	10,401,629											
1914.	16,641,132											

<sup>a</sup> Figures in italics represent incomplete fatality records.

<sup>b</sup> Not reported.





	a Causes not given in official report.										b No accidents included in published report.										c No report published.									
	25	2	6	4	2	11	1	1	1	47	2	2	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1910.....	17	2	4	1	2	11	1	1	1	47	2	2	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1911.....	20	5	8	2	2	11	1	1	1	40	3	2	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1912.....	24	3	8	7	2	4	1	1	1	34	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1913.....	18	3	4	2	1	6	2	2	2	59	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1914.....										40																				

## IOWA.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal fields of Iowa are in the Pennsylvanian series of the Carboniferous system and occupy the central and southern part of the State. The total coal-bearing area is about 20,000 square miles, of which 13,000 square miles include outcropping coal beds that are considered workable under the present economic conditions. In 1913, 21 counties were reported as coal producers.

The principal producing areas are in Marion, Mahaska, Monroe, and adjacent counties, which produced 43 per cent of the coal in 1913; Polk, Jasper, and Dallas counties of the same group produced 32 per cent; and Appanoose and Wayne counties, containing the Mystic or Centerville bed, produced 17 per cent. This bed is very persistent over a considerable area.

### CHARACTER OF COAL BEDS.

The Iowa coal is bituminous, non-coking, and contains a high percentage of sulphur in the form of pyrite. The coal is used largely for steaming purposes. Practically all of the beds are horizontal or dip about 10 feet per mile. Most of the coal beds are opened by shafts of different depths, as follows: Lucas County, 321 feet; Appanoose and Wayne counties, 200 feet; Adams County, 400 feet; Polk County, 156 feet; Webster County, 16 to 100 feet; and Marion County, 150 feet. There are a few slope and drift mines.

The coal beds of the Des Moines group (the lower part of the Pennsylvanian series) vary from  $3\frac{1}{2}$  to 5 feet or more in thickness and, with the exception of the Mystic bed, are somewhat faulted and irregular. The thickest coal in the State occurs in Marion County, where beds 4 to 12 feet thick have been opened. The Mystic or Centerville bed is about  $2\frac{1}{2}$  feet thick, has a strong roof, and is adapted to longwall mining methods.

### MINING METHODS.

Coal mining in Iowa began about 1840, for which year the records show a production of 400 tons. The production has gradually increased until in 1913 it was 7,525,936 tons.

Nearly all of the mines are operated through shafts and the coal is mined by the longwall and room-and-pillar methods. In 1891, 9 machines were introduced into the mines and the number gradually increased to 56 in 1898. Since that date the number of machines has been gradually reduced. Of 62 mines in Appanoose County in 1904, 16 used the room-and-pillar method and 46 the longwall method. Longwall mining machines are used rather extensively. A large amount of coal is shot off the solid, but records showing the extent to

which this is practiced are not available prior to 1911. In 1912, 69 per cent, and in 1913, 72.3 per cent of the total production was shot off the solid. The hand-mined coal amounts to about 20 per cent of the total, while that produced by machines is less than 2 per cent.

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

Section 1567 of the Iowa Code of 1873 directed that the board of supervisors of each county in which coal or other minerals were found should appoint an inspector of mines, who, upon application of mine owners, operators, or employees, examined the atmosphere of such mines as affecting life or health. If gas was found in sufficient quantities to jeopardize life or health, the inspector was authorized to require the operator to provide additional shafts or entrances for proper ventilation, and a penalty was provided for failure to carry out such demands of the inspector.

On March 18, 1874, the foregoing provisions were superseded by a law requiring the county inspectors, who were appointed as under the previous law, to examine each mine twice a year, provided more than 10 miners were employed therein. Operators were required, under penalty, to notify the inspector of all fatal and serious accidents, and, if fatal, to notify the county coroner also. The inspector was required to examine into the causes of accidents and to preserve a record of his inspections. The law of March 30, 1880, consolidated the inspection service under the jurisdiction of one State mine inspector appointed by the governor. The act applied only to mines employing more than 15 men, and the inspector was required to make an annual report to the governor, enumerating therein all accidents in and about the mines. An act approved March 18, 1884, extended the inspection law to cover all mines employing more than five men, and required the inspector to render biennial reports to the governor on August 15 preceeding the regular session of the State legislature.

On April 10, 1886, the governor was authorized to divide the State into three districts and appoint a mine inspector for each district, the inspectors to report to the governor as before. A law of April 12, 1888, provided for a board of examiners to examine candidates for the office of mine inspector. By an act approved May 6, 1911, mine operators were required to report on August 1 of each year to the district inspector, for the year ending July 1, the number of employees in and around the mines, in addition to sending to the inspector an immediate notice of fatal and nonfatal accidents.

All injuries, whether serious or slight, are reported to the district mine inspectors, but only those causing disability for at least 10 days are considered serious injuries and published in the inspectors' annual reports.



## ACCIDENTS.

The accompanying tables, Nos. 99 and 100, show the total number of fatalities by causes and calendar years since 1880, as compiled from the State mine inspectors' reports. These tables also show the percentage of accidents, classified by principal causes, and fatality rate per 1,000 men employed, over a period of 26 years for which

FATALITIES IN **IOWA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1888 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	426	59.00	1.31
Mine cars and locomotives.....	76	10.53	.23
Gas and dust explosions.....	44	6.10	.13
Explosives.....	74	10.25	.23
Miscellaneous.....	18	2.49	.06
Shaft.....	65	9.00	.20
Surface.....	19	2.63	.06
Total, 26 years.....	722	100.00	2.22

COAL-MINE ACCIDENTS IN **IOWA** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1893, Feb. 14.....	Chicago and Iowa.....	Albia.....	Mine explosion.....	8
1902, Jan. 24.....	Lost Creek No. 2.....	Oskaloosa.....	Do.	20

continuous records are available. The fatality rate during this period is 2.22 per 1,000 men employed. Iowa has been fortunate in that there have been but two disasters, in which five or more men were killed at one time. The fatalities represented by these two disasters are only 4 per cent of the total number killed during the above period. Of the total number of fatalities, 59 per cent were due to falls of roof and pillar coal, 10.53 per cent to mine cars and locomotives, and 10.25 per cent to explosives. The average production of coal per fatality during this period was 204,390 tons, or 4.89 fatalities for each million tons mined.

Since Iowa is an eight-hour State, the time element has been taken into consideration, and tables have been compiled on this basis for comparison with other States. The fatality rate for the 10-year period, 1903-1913 (Table 40), based upon the actual number of employees, is 1.94, whereas based on the number of 2,000-hour workers it is 2.27. During the 10-year period the men averaged 1,704 hours per year, as compared with 2,447 hours for Virginia. Table 41 shows

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN IOWA.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	237	12,689	3	27			1,446	14,162
1904.....	261	15,221	1	10	1	10	388	15,629
1905.....	186	13,569	5	56	3	22	1,466	15,113
1906.....	195	14,869	2	20	1	8	363	15,260
1907.....	175	15,171	1	10			404	15,585
1908.....	218	14,772	3	28	4	24	1,197	16,021
1909 <sup>b</sup> .....								17,286
1910.....	229	16,238	2	10	3	11	407	16,666
1911.....	196	16,065	3	16			741	16,852
1912.....	194	15,806	1	9	1	4	551	16,370
1913.....	185	15,248	2	16	1	12	481	15,757

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN IOWA AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day. (All employees.)	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	226	114,769	25,937,894	12,969	27	2.08
1904.....	213	125,450	26,720,850	13,360	25	1.87
1905.....	209	122,470	25,596,230	12,798	37	2.89
1906.....	224	122,479	27,435,296	13,718	29	2.11
1907.....	230	125,094	28,771,620	14,386	40	2.78
1908.....	214	129,441	27,700,374	13,850	31	2.24
1909 <sup>a</sup> .....						
1910.....	218	133,767	29,161,206	14,581	33	2.26
1911.....	203	135,573	27,521,319	13,761	38	2.76
1912.....	188	131,528	24,727,264	12,364	19	1.54
1913.....	195	126,577	24,682,515	12,341	26	2.11

<sup>a</sup> Census year.

the fatality rate for each year on the 2,000-hour basis (1903-1913) for each State, so that a true comparison of Iowa with other States may be readily made. The tables of statistics for the State of Iowa follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN IOWA.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	2,623	72,710	28	1907.....	1,621	8,265	5
1900.....	1,322	62,333	47	1908.....	5,248	121,087	23
1901.....	401	16,171	40	1909.....	2,036	12,504	6
1902.....	363	6,480	18	1910.....	9,209	408,563	44
1903.....	1,143	11,365	99	1911.....	1,622	31,870	20
1904.....	8,303	173,781	21	1912.....	8,455	370,449	44
1905.....	1,774	10,353	6	1913.....	721	13,538	19
1906.....	7,969	204,860	28	1914.....	2,642	76,791	29

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





1903.....	6,419,811	1.65	14,162	27	1.91	4.21	237,771	226	453	2.00	.9	(a)	(a)	11	10	10	10	244			
1904.....	6,519,483	1.61	15,629	25	1.40	3.83	290,797	213	417	1.96	2.7	(a)	(a)	11	10	10	10	39			
1905.....	6,798,669	1.56	15,113	37	2.45	5.44	185,746	209	450	2.15	2.7	(a)	(a)	9	9	14	14	267			
1906.....	7,205,224	1.60	15,200	29	1.90	3.99	250,559	224	476	2.13	2.7	(a)	(a)	11	14	9	9	32			
1907.....	7,574,822	1.62	15,585	40	2.57	5.28	189,358	220	486	2.11	1.4	(a)	(a)	16	9	8	8	34			
1908.....	7,161,310	1.63	16,021	31	1.93	4.33	231,010	214	447	2.09	1.0	(a)	(a)	19	9	8	8	33			
1909.....	7,757,762	1.65	17,286	39	2.26	5.03	198,917	(b)	449	(b)	1.1	(a)	(a)	5	5	5	5	28			
1910.....	7,928,120	1.75	16,666	33	1.98	4.16	240,246	218	476	2.18	.3	(a)	(a)	11	6	6	6	309			
1911.....	7,831,648	1.73	16,852	38	2.25	5.18	192,938	203	435	2.14	15.2	6	68.4	15.8	10	6	3	2	268		
1912.....	7,289,329	1.80	16,370	19	1.16	2.61	383,650	188	445	2.37	19.9	1.3	69.1	9.7	16	3	1	1	20		
1913.....	7,525,036	1.79	15,757	26	1.65	3.45	280,459	195	478	2.45	20.2	1.6	72.3	3.9	3	7	8	2	219		
Total.....	186,603,097	.....	.....	844	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	253	
Average(1888-1913)	5,675,758	.....	12,508	27.77	2.22	4.89	204,350	211	454	2.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
1914.....	7,451,022	1.79	16,057	37	2.30	4.97	201,379	204	464	2.27	19.5	4.1	74.4	2.0	2	4	18	21	1	46	190

b Not reported.

a Included in hand mining, column 11.







## KANSAS.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal-bearing measures of Kansas comprise about 18,600 square miles, of which 3,100 square miles are known to contain workable coal beds. The coal-bearing area occupies a strip covering about 3 to 4 counties wide entirely across the eastern end of the State, but the best beds are found in Cherokee and Crawford counties in the southeast corner.

The coal beds of this State belong to the Carboniferous system and occur in the southwest extension of the coal-bearing rocks of the Iowa-Missouri field. About 90 per cent of the coal mined in the State is from the Weir-Pittsburgh beds in Crawford and Cherokee counties. About 6 per cent of the coal is produced in the Atchison-Leavenworth district from a depth of 700 feet to 1,150 feet.

### CHARACTER OF COAL BEDS.

The coal beds of Crawford and Cherokee counties are practically horizontal, and occur at depths of 30 feet to 250 feet. The coal is bituminous, and produces a large amount of dust when mined. The beds vary in thickness from 3 to 10 feet, those in the Cherokee shale being very irregular. The thicker parts of the workable beds lie in "swamps" or basins of very irregular outline. Rolls in the floor and roof cause differences of level of 20 to 30 feet in many of the mines and a difference of as much as 60 feet has been observed in a single mine. It seems that these irregularities are due to unevenness of the original bottom upon which the coal was formed.

### MINING METHODS.

The earliest statistics of coal production in Kansas are for 1869, when 36,891 tons were mined. In 1913, the production was 7,202,210 tons. Practically all of the coal is mined by the room-and-pillar system, but some longwall mining is done in Osage County. About 85 per cent of the mines are opened by shaft; 11 per cent are strip pits, and 4 per cent are drift mines. In southeastern Kansas considerable coal is mined by stripping with a steam shovel. In places as much as 40 feet of cover is removed in stripping.

Mining machines were introduced into Kansas about 1897 but their use has been confined to a limited number of mines. In 1908, there were 17 machines in use; in 1913, only 9 were used, producing 0.3 per cent of the coal mined in the State, 14.8 per cent was mined by hand, and 85.5 per cent was shot off the solid.

The State mine inspector in his report for 1913 states that in Crawford and Cherokee counties 982,546 12½-pound kegs of powder were

used, or one keg for every 7.22 tons of coal produced. In addition, he also estimates that 1,029,000 pounds of dynamite and 46,450 pounds of permissible powder were used.

He also states that:

The extreme danger in the increased and excessive amount of explosives used is hereby made apparent and can not be gainsaid. Had these figures of dynamite and permissible powder been reversed the condition under which the mines were operated, in my opinion, would have been vastly improved as far as their safety is concerned. This may also account in a certain measure for the grade of coal produced at some of the mines.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The governor of Kansas was authorized by an act approved February 27, 1883, to appoint an inspector of coal mines for two years from June 30, 1883. Mine operators were required to report to the inspector all accidents causing serious or fatal injuries, and, if fatal, to the coroner of the county in which the mine was located. A monthly report by the inspector, showing the number of accidents and deaths from injuries and number of men employed, was required to be filed with the secretary of the State board of agriculture on or before the first Monday in each month. The act of March 13, 1885, required the inspector to render annual reports to the governor on the 1st day of February of each year. The mine operators were required by the act of March 13, 1897, to render quarterly reports of accidents to the State mine inspector. The method of selecting the mine inspector was changed by an act approved January 6, 1899. By this act an association of miners was authorized, consisting of a delegate from each organized body of five or more miners in any county, city, or mining camp in the State. The State association held annual meetings and elected a president, vice president, and secretary, and the secretary so elected succeeded to the duties of State mine inspector.

On February 5, 1913, an act was approved creating a department of labor and industry under the control of a commissioner of labor and industry. The commissioner was made ex officio factory and mine inspector, with authority to appoint an assistant of at least five years' experience in coal mining. In 1914 the inspection of coal mines was carried on by the assistant commissioner and five deputies.

All injuries, whether serious or slight, are reported to the inspector and are included in his annual reports, but no definition is given as to what constitutes a serious or slight injury.

## ACCIDENTS.

Tables 101 and 102 show, by causes and calendar years, the total number of fatalities since 1884, excepting 1886, 1888, and 1892, for which years reports are not available. These tables also show the percentage of accidents, classified by principal causes, and fatality rate per 1,000 men employed for a period of 21 years for which continuous records are available. The fatality rate during this period is 2.45 per 1,000 men employed. Of the total number killed

FATALITIES IN **KANSAS** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1893 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	259	49.05	1.20
Mine cars and locomotives.....	12	2.27	.06
Gas and dust explosions.....	33	6.25	.15
Explosives.....	131	24.81	.61
Miscellaneous.....	26	4.93	.12
Shaft.....	50	9.47	.23
Surface.....	17	3.22	.08
Total, 21 years.....	528	100.00	2.45

COAL-MINE ACCIDENTS IN **KANSAS** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1888 Nov. 9.....	Shaft No. 2.....	Frontenac.....	Mine explosion.....	40
1906 Dec. 20.....	Fidelity No. 1.....	Stone City.....	Powder explosion.....	7
1911 Mar. 18.....	No. 16.....	Mineral.....	Mine explosion.....	5
1914 Jan. 14.....	Spencer-Newland.....	Mulberry.....	Cage with men fell down shaft.	6

(1893-1913), 49.05 per cent of the fatalities were due to falls of roof and pillar coal, and 24.81 per cent to explosives. The amount of coal mined by shooting off the solid is approximately 80 per cent of the total production. The average production of coal per fatality during the 21 years was 203,153 tons, or 4.92 fatalities for each million tons mined. The average production per man a year was 497 tons, or 2.56 tons per day.

During the period 1884 to 1913, inclusive, there were three mine disasters in which 52 men were killed, representing slightly less than 8½ per cent of the total number killed in the coal mines of Kansas.

In Kansas, more than 95 per cent of the men are on an eight-hour basis, and for comparative purposes the time element has been taken into consideration and tables compiled. It will be noted that the fatality rate for the 10-year period, 1903-1913 (Table 40), based on actual number of employees, was 2.70 per 1,000 men employed, and reduced to a 2,000-hour basis was 3.45 per 1,000. Table 41 shows



NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN KANSAS.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	145	9,965	9	447	8	62	450	10,924
1904.....	151	11,599	9	215	5	45	339	12,198
1905.....	121	11,004	6	129	5	54	739	11,926
1906.....	141	12,606	7	94	3	399	1,256	14,355
1907.....	134	10,980	10	156	1	10	1,293	12,439
1908.....	138	12,973	11	283	7	363	297	13,916
1909 <sup>b</sup> .....								12,359
1910.....	126	12,255	9	115	1	5	495	12,870
1911.....	121	10,989	7	177			657	11,823
1912.....	132	11,186	7	380			80	11,646
1913.....	138	12,240	1	5			234	12,479

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

## NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN KANSAS, AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	215	88,413	19,008,795	9,504	33	3.47
1904.....	213	98,228	20,922,564	10,461	31	2.96
1905.....	212	96,384	20,433,408	10,217	41	4.01
1906.....	165	116,988	19,303,020	9,652	39	4.04
1907.....	225	100,981	22,720,725	11,360	37	3.26
1908.....	181	112,634	20,386,754	10,193	38	3.73
1909.....						
1910.....	148	103,580	15,329,840	7,665	17	2.22
1911.....	190	95,418	18,129,420	9,065	42	4.63
1912.....	202	93,628	18,912,856	9,456	30	3.17
1913.....	197	100,071	19,713,987	9,857	28	2.84

the fatality rate for each year on the 2,000-hour basis (1903-1913) for each State, so that a true comparison of Kansas with other States may be readily made.

The tables of statistics for the State follow.

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN KANSAS.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	1,986	88,798	45	1907.....	923	16,957	18
1900.....	157	3,590	23	1908.....	11,155	665,224	60
1901.....	60	3,300	5	1909.....	4,715	71,566	15
1902.....	334	17,256	52	1910.....	10,346	1,578,027	153
1903.....	328	2,516	8	1911.....	984	8,507	9
1904.....	186	1,214	7	1912.....	2,088	13,487	65
1905.....	1,482	14,686	10	1913.....	3,178	28,936	9
1906.....	11,827	709,422	59	1914.....	2,673	45,257	17

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 101.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN KANSAS, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.<sup>a</sup>

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 and all items above horizontal lines in columns 2 and 3 from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10 prior to 1900, calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.				
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial ax or post.	Total.					
1869-1883.	5,068,071																								
	1,100,000	1884		3		2.73	366,667																		
	1,212,057	1885	4,175	9	2.16	7.43	134,673		290																
	1,400,000	1886																							
	1,596,879	1887		6		3.76	266,147																		
	1,850,000	1888	\$1.50	40					514																
	2,221,043	1889	1.48	12	2.01	5.40	185,087	(b)	373																
	2,259,922	1890	1.30	8	1.77	3.54	282,490	210	500	2.38															
	2,716,705	1891	1.31	11	1.77	4.05	246,973	222	438	1.97															
	3,007,276	1892	1.32	14				208	458	2.20															
	2,652,546	1893	1.27	14	1.92	5.28	189,468	147	363	2.47															
	3,398,251	1894	1.23	24	3.27	7.08	141,177	164	462	2.62															
	2,926,870	1895	1.20	11	1.47	3.76	266,079	159	391	2.46															
	2,884,801	1896	1.15	12	1.68	4.16	240,400	168	405	2.41															
	3,054,012	1897	1.18	6	.90	1.96	509,002	194	460	2.37		0.2													
	3,406,555	1898	1.09	17	2.36	4.99	200,386	194	473	2.44		.3													
	3,852,267	1899	1.16	16	2.00	4.15	240,767	226	482	2.13		1.0					3								
	4,467,870	1900	1.22	21	2.48	4.70	212,756	232	528	2.28		1.0													
	4,900,528	1901	1.22	11	1.11	2.24	445,503	224	494	2.21		.8													
	5,266,065	1902	1.30	28	2.96	5.32	188,074	220	557	2.53		.9													
	5,839,976	1903	1.52	33	3.02	5.65	176,969	215	535	2.49		.2					3								
	6,333,307	1904	1.52	31	2.54	4.89	204,300	213	519	2.44		.2					3	2							
	6,423,979	1905	1.46	41	3.44	6.38	156,682	212	539	2.55		.3					10								
	6,024,775	1906	1.49	39	2.72	6.47	154,481	165	420	2.55		.5					6								

[illegible]

*a* Figures in italics represent incomplete fatality records.

Not reported.



TABLE 102.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN KANSAS, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1884 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1884.	2					5						3	7			2										3
1885.																										9
1886 <sup>a</sup>																										
1887.	2				3								5	1					1							6
1888 <sup>a</sup>					40								11						1							40
1889.	6	2				3							11			1			3							12
1890.	4					1							5			3			1							8
1891.	4		1			2							1	11												11
1892 <sup>a</sup>																										
1893.	3		1			2						5	11		1		2			3						14
1894.	10				2	4						16	8		3		2						2		1	24
1895.	5					1						1	10													11
1896.	5					5							5													12
1897.	4					2							17													6
1898.	7				3	5							5			1										17
1899.	8					5							14													16
1900.	12					6							19			1			1							21
1901.	4					5							1	7		1		2		4						11
1902.	12					7							23	3		2				5						28
1903.	19		2			7	1						28	1		1				6						33
1904.	15					11							39	1		2				3						41
1905.	23		2		2	13							39	1						3						31
1906.	14	1	1			20							36	1						2						39
1907.	21			1	3	6							32	1		1				1						37
1908.	22					8							31	1												38
1909.	18		1	3		9							31	1												32
1910.	7				1	3			1				12	4												17
1911 <sup>b</sup>	20			7	3		3					3	40							4						44

1912	13	2	1	11	1	28	1	1	1	30
1913	17	1	2	4	1	25	2	1	1	28
1914	14	8	1	1	1	25	7	1	1	33

a No report issued. The 40 fatalities shown in 1888 are those resulting from the explosion at the Frontenac mine, Nov. 9.

<sup>b</sup> On July 7, 1911, the State records were burned before the inspector published his report. Hence no report was issued for the fiscal year ending June 30, 1911. Figures for 1910 and 1911 were compiled by the Bureau of Mines from operators' reports.

## KENTUCKY.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The two coal fields of Kentucky are located in the extreme eastern and western parts of the State.

The Eastern coal field has an area of about 10,270 square miles, of which about 70 per cent may be considered as productive. The rocks in this field are practically horizontal, except those in Bell and Harlan counties, which lie in the great synclinal trough east of Pine Mountain. In the middle of this trough the coal beds are flat-lying, but on either rim they dip steeply toward the axis of the trough. The stresses which caused the great trough have produced several minor folds in its bottom and also a few faults, which cause considerable trouble and expense in mining. The principal producing counties are Bell, Floyd, Harlan, Johnson, Knox, Laurel, Lee, Letcher, Perry, Pike, and Whitley. In 1913, the field produced 11,098,906 tons, as compared with 8,517,640 for the Western field.

The Western field is a continuation of the Indiana-Illinois field and has a coal-bearing area of about 6,400 square miles, of which 65 per cent may be considered as productive. This field, which includes Butler, Daviess, Hancock, Henderson, Hopkins, McLean, Muhlenberg, Ohio, and Webster counties, is the southeastern part of the big flat basin that carries the coal of Indiana and Illinois, but the rocks are much more disturbed in the Kentucky part than they are in those parts lying in the other States. The line of disturbance, extending in an east-west line across southern Illinois, continues across the western Kentucky field. Along this line from Shawneetown, Illinois, to Litchfield in Grayson County, the rocks are tilted and broken by faults to such an extent that mining is difficult and expensive.

### CHARACTER OF COAL BEDS.

The Eastern field belongs to the Pottsville group of the Allegheny formation and contains 12 or more coal beds of workable thickness and quality. The coal of these beds is usually of high-grade gas or coking quality and some of it is cannel coal. The Blue Gem and Jellico beds, which extend into Tennessee, average about 22 inches thick. This coal is extensively mined and finds a ready market as a domestic and steam fuel. Other coal beds contain 8 to 9 feet of workable coal. In Breathitt County one of the coal beds that is extensively worked is 30 inches thick and has a thin shale roof above which is a stratum of limestone. In Pulaski County, one of the important beds is 35 inches thick and has a dip of about 1 per cent. In Bell County, one of the most productive beds is 36 to 42 inches thick and is horizontal.



There are three important coal beds that are worked in various parts of the western district. Coal A (No. 12) is about 80 inches thick at the Pierce mine in Muhlenberg County, it is of excellent steaming quality and has been used to a limited extent for coking, but is not of commercial importance for this use. The thickness of this bed varies and in general the roof is fire clay and shale. Coal B (No. 11), known also as the Danville bed, is one of the principal sources of commercial coal. It varies in thickness from 12 to 84 inches and is cut by clay slips and disturbed by rolls. It is 40 to 100 feet below the surface and is 25 feet below the No. 12 coal. At the Pierce mine, Muhlenberg County, the coal is 78 inches thick, and in Hopkins County, is about 84 inches thick. At Madisonville there is a thin stratum of shale between the coal and a limestone capping, whereas at Nortonville the limestone rests directly on the coal. Bed D (No. 9, equivalent of No. 5, Illinois) is more regular than the other coal beds and produces about 75 per cent of the coal of the western district. It is 56 to 60 inches thick and extends throughout the larger part of 8 counties. It is about 300 feet below the surface and is opened by shafts. Coal Fb (No. 5), also known as the "Four-foot" coal, is extensively mined at De Koven, Union County, where it has a maximum thickness of 54 inches. The roof is black shale  $1\frac{1}{2}$  to 2 feet thick. There are a number of other coal beds in the State, varying in thickness from a few inches to 40 and 50 inches, some of which are worked.

#### MINING METHODS.

Coal mining in Kentucky began in a small way in 1828, during which year 328 tons were reported as the annual production. The production has gradually increased until in 1913 it was 19,616,600 tons. The majority of the coal is mined by the double-entry, room-and-pillar method. In the eastern part of the State practically all of the mines are opened by drift or slope, whereas in the western field there are a number of shaft mines. In 1900 there were 23 shaft mines in the State, the others being opened by slopes or drifts. The following description <sup>a</sup> given by Dr. C. J. Norwood covers the mining methods of the year 1889.

Almost without exception, the mines of Kentucky are worked on the "pillar-and-room" system, with either single (with parallel air course) or double entry, usually the former. Sometimes one portion of the bank will be worked with single entry and another portion with double. The only two instances, known to the writer, in which long wall was tried resulted in failure; and one instance in which square work was attempted resulted in crushed pillars. The rooms are usually turned every 30 or 33 feet, and widened to from 18 to 21 feet. The necks are usually 6 to 12 feet long by 6 to 8 feet wide in the western field, and 8, 12, 18, or 20 feet long by 6 to 9 feet wide in the eastern field. The lengths of the rooms vary so greatly that a general statement on

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<sup>a</sup> Report of the inspector of mines of Kentucky, 1889.

that point can not well be given. Sometimes they are driven a distance of 600 feet from one entry through to the other; again, rooms are started from parallel entries to meet midway, and will be driven up only 200 to 250 feet.

In the western field the rooms are almost invariably single. In the eastern one they are often double, or two rooms are worked from a single "parting."

It is not uncommon for rooms to be turned from the main entry, in the eastern field; in the western one it is seldom done.

In both fields single entry, with parallel air-course (rooms sometimes being turned from the air-course), is the more common of the two systems followed. Double entry is oftener followed in the western field than in the eastern. Sometimes, when single entry with parallel air-course is adopted it is ultimately modified, in order to curtail expenses, by continuing room width what began as narrow work.

In the eastern field all of the openings, with one exception, (a short slope), are drifts, considerably above the level of drainage. (And the mines there are the wettest in the State). In the western one, the coals are reached by shafts, slopes and drifts.

These methods have not changed materially except possibly in the increased number of mining machines since their introduction in 1884. In 1893, there were 70 machines in operation in the Kentucky coal mines, which produced 20 per cent of the State's output. The number of machines has gradually increased until in 1913, 1,263 mining machines produced 73.2 per cent of all of the coal mined in Kentucky.

Shooting off the solid has been and still is prevalent in Kentucky, but with the increase in the number of mining machines, there is a slight decrease in the amount of coal shot off the solid. In 1911, 16.2 per cent of the coal was thus mined and in 1913, 15.7 per cent.

A large amount of the underground haulage is by mules, which are used largely for gathering the coal from the working face and delivering it to a rope haulage or electric haulage system.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The mine-inspection law of Kentucky was approved by the governor and became effective May 10, 1884. The law related only to mines in which more than 5 persons were employed at one time. The first State inspector was appointed May 12 and entered on duty May 14, 1884. He was required, among other things, to report to the governor not later than October 10 on the condition and operation of the coal mines and to enumerate in his report all accidents in or about the mines. The law, however, contained no provisions compelling operators to report accidents to the State inspector, and the official record of mine accidents in Kentucky from 1884 to 1888 is therefore somewhat incomplete. The defect in the original law was remedied by an act approved April 6, 1888, making it the duty, under penalty, of mine operators to furnish accurate information to the State inspector, on blanks supplied by him, as to all accidents in or about the mines.

An act approved March 23, 1914, designated the office of inspector of mines as the department of mines and changed the inspector's title to chief inspector of mines. The act applies to all coal mines in which 6 or more men are employed, and requires the superintendents of such mines to render to the chief inspector monthly reports of all fatal and serious accidents, showing the cause of such accidents, and such other information as the chief inspector may require. Fatal accidents are also required to be reported immediately to the district inspector. Each district inspector is required to examine each mine in this district at least once every four months. Monthly reports are rendered by the assistant inspectors to the chief inspector, and annual reports are rendered to the chief inspector within 60 days after the close of the calendar year. The act requires that the chief inspector shall prepare and file his annual report for printing within six months after the close of the calendar year.

The first assistant inspector was provided for by the acts of December 3, 1892, and June 9, 1893, and he entered upon his duties July 1, 1893. Since that time the inspection force has been further increased, so that in 1915 the force consisted of one chief inspector and five assistant inspectors.

It is the practice of mine operators to report to the inspector all accidents causing death or injury resulting in disability for at least 7 days, and all such accidents are published in the inspector's annual reports. Nonfatal injuries are classified into three classes: Serious, severe but not serious, and slight. The inspector has defined these classes as follows: Serious injuries include fractures, paralysis, dangerous injuries to internal organs, injuries permanently affecting muscles (as may come from burns, cuts, lacerations), dislocations, injuries necessitating amputation, crushed bones, and injuries of similar importance; severe but not serious injuries include those that, while they may be painful and cause loss of a week or more, leave no permanent effects or are not dangerous, such as bruises, cuts, and strains; slight injuries include bumps, scratches, strains and minor hurts that cause no cessation of work, or only for a few days (less than a week). Slight injuries are not recorded in the inspectors' annual reports.

#### ACCIDENTS.

The accompanying State tables (Nos. 103 and 104) show the total number of fatalities by causes and calendar years since 1884, as compiled from the State mine inspector's reports. They also show the percentage of accidents and fatality rates per 1,000 employed by principal causes, over a period of 26 years (1888-1913) for which continuous records are available. The fatality rate during this period is 1.98 per 1,000 men employed. There were 10 accidents in which 5 or more men



# 208 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

FATALITIES IN **KENTUCKY** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1888 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	316	49.76	0.98
Mine cars and locomotives.....	46	7.25	.14
Gas and dust explosions.....	74	11.65	.23
Explosives.....	89	14.02	.28
Miscellaneous.....	39	6.14	.12
Shaft.....	24	3.78	.08
Surface.....	47	7.40	.15
Total, 26 years.....	635	100.00	1.98

## COAL-MINE ACCIDENTS IN **KENTUCKY** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1895 Jan. 22.....	Tate.....	Sturgis.....	Powder or mine explosion.....	5
1904 Apr. 20.....	Stearns No. 5.....	Stearns.....	Mine explosion.....	5
1908 Feb. 10.....	Moody.....	South Carrollton.....	Blown-out shot.....	9
1909 Dec. 11.....	Baker No. 5.....	Clay.....	Mine explosion.....	7
1910 Feb. 1.....	Browder.....	Browder.....	Powder and mine explosion.....	34
1910 Feb. 8.....	Barthell No. 1.....	Stearns.....	Mine explosion.....	6
1910 Nov. 25.....	Providence No. 3.....	Providence.....	Powder and mine explosion.....	10
1912 Jan. 19.....	Central.....	Central City.....	Mine explosion.....	5
1912 Apr. 21.....	Coil.....	Madisonville.....	do.....	5
1913 May 6.....	Taylor.....	Hartford.....	Overcome by gas.....	5

were killed at one time, or a total of 91 men, representing 14 per cent of all fatalities. The average production of coal per fatality during this period was 292,541 tons.

During recent years about one-half of the men were on a 10-hour basis; one-fourth on 9 hours, and one-fourth on 8 hours. The time element has been taken into consideration and a table compiled on

## NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **KENTUCKY**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	49	3,372	42	3,779	84	6,157	1,046	14,354
1904.....	58	3,870	60	4,208	141	5,952	205	14,235
1905.....	50	3,445	52	4,050	94	5,995	1,195	14,685
1906.....	60	4,171	65	3,972	79	5,941	1,188	15,272
1907.....	60	4,610	71	4,508	97	6,842	1,011	16,971
1908.....	56	4,636	52	2,072	132	9,166	1,122	16,896
1909 <sup>b</sup> .....								16,903
1910.....	69	6,095	56	3,965	126	9,064	1,192	20,316
1911.....	79	6,103	46	4,789	144	10,289	2,943	24,124
1912.....	69	6,037	58	4,901	149	11,815	1,551	24,304
1913.....	68	5,754	84	7,889	147	12,390	799	26,332

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.



NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **KENTUCKY**, AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1900.....	207	131,971	27,317,997	13,659	27	1.98
1901.....	197	130,197	25,648,809	12,824	20	1.56
1905.....	200	134,715	26,943,000	13,472	31	2.30
1906.....	212	139,218	29,514,216	14,757	39	2.64
1907.....	210	154,971	32,543,910	16,272	32	1.97
1908.....	186	157,494	29,293,884	14,647	40	2.73
1909.....						
1910.....	221	185,813	41,064,673	20,533	86	4.19
1911.....	201	221,302	44,481,702	22,241	44	1.98
1912.....	201	224,514	45,127,314	22,564	51	2.26
1913.....	212	243,624	51,648,288	25,824	48	1.86

this basis for comparison with data on other States. The rate for the 10-year period (1903-1913) under consideration, based on the actual number of employees is 2.23 per 1,000, whereas on the number of 2,000-hours workers it is 2.36 per 1,000 (Table 40). During the 10-year period the men worked 1,885 hours per annum as compared with 2,447 hours per annum in Virginia. The tables of statistics for the State of Kentucky follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **KENTUCKY.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	837	24,598	29	1907.....	1,325	53,916	41
1900.....	2,946	90,095	31	1908.....	1,002	26,941	27
1901.....	933	32,707	35	1909.....	275	16,500	60
1902.....	1,248	22,184	18	1910.....	1,475	15,197	10
1903.....	599	13,717	22	1911.....	1,080	34,008	32
1904.....	3,781	144,245	39	1912.....	2,759	79,685	29
1905.....	923	62,651	68	1913.....	1,029	18,638	18
1906.....	1,242	44,812	36	1914.....	2,250	82,919	37

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 103.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN KENTUCKY, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 and all items above horizontal lines in columns 2, 3, 8, 12, 20, and 21 from State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

1907.....	10,753,124	1.06	10,971	32	1.89	2.98	336,035	210	634	3.02	.....	51.2	.....	475	205	28	.....	708	.....
1908.....	10,246,553	1.01	16,996	40	2.35	3.90	286,164	186	603	3.24	.....	51.3	.....	515	209	35	.....	759	.....
1909.....	10,687,384	.94	16,903	34	2.01	3.18	314,629	(a)	633	(a)	.....	60.5	.....	547	310	20	.....	827	287
1910.....	14,623,319	.99	20,316	86	4.23	5.88	170,039	221	720	3.26	.....	64.0	.....	536	325	37	1	899	290
1911.....	14,049,703	.99	24,124	44	1.82	3.13	319,311	201	582	2.90	.....	65.4	16.7	544	314	72	57	987	306
1912.....	16,490,521	1.02	21,304	51	2.10	3.09	323,344	201	679	3.38	.....	66.4	16.5	611	361	54	136	1,168	352
1913.....	19,616,600	1.05	26,332	48	1.82	2.45	408,679	212	745	3.51	.....	73.2	15.7	574	377	98	13	1,263	331
Total.....	208,128,654	.....	.....	650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average (1883-1913).....	7,144,744	.....	12,361	24.42	1.98	3.42	292,541	201	578	2.88	.....	77.2	11.6	590	369	40	367	17	1,383
1914.....	20,382,763	1.02	28,764	61	2.12	2.99	334,144	187	709	3.79	.....	.....	.....	.....	.....	.....	.....	.....	355

a Not reported.

TABLE 104.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN KENTUCKY, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1884 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.		
	Total.										Total.						Total.								
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and lo- comotives.		Other causes.	Total.
1884.....	1	3	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
1885.....	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
1886.....	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
1887.....	3	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
1888.....	9	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
1889.....	7	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
1890.....	6	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
1891.....	10	1	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	16
1892.....	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
1893.....	9	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
1894.....	6	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
1895.....	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
1896.....	4	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
1897.....	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
1898.....	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
1899.....	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
1900.....	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17
1901.....	5	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
1902.....	11	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
1903.....	17	—	1	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	27
1904.....	6	—	1	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
1905.....	19	—	2	—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	31
1906.....	17	3	2	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	39
1907.....	11	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	32
1908.....	15	—	3	—	9	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	39
1909.....	20	—	2	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	40
1910.....	20	1	5	7	40	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	34
1911.....	28	—	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44
1912.....	19	1	5	5	5	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	41
1913.....	24	—	1	—	—	1	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	45
1914.....	30	—	13	—	1	6	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	61

<sup>a</sup> Includes 5 fatalities at mine not under jurisdiction of inspector.



**MARYLAND.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal fields of Maryland, a southward extension of those in Somerset County, Pa., occupy a strip along the western border of Allegany County about 20 miles long and averaging 5 miles in width and the greater part of Garrett County, comprising a total area of 455 square miles. The coal measures occupy broad, open, north and southwest synclinal folds, which are separated by eroded anticlines and are in the lower Carboniferous or Devonian rocks. There are five basins, known as Georges Creek, Upper Potomac, Castleman, Lower Youghiogheny, and Upper Youghiogheny. The present production of coal is almost exclusively mined from the first two basins. The prominence of the Georges Creek basin has led to the use of the name of Georges Creek coal, and until recent years practically all of this coal came from the Pittsburgh seam or "Big Vein." The coal beds are usually flat, seldom attaining a dip of 10°.

**CHARACTER OF COAL BEDS.**

The following description of the principal coal-producing beds of Maryland is taken from the report<sup>a</sup> of the Maryland Geological Survey on Allegany County for the year 1900:

The Elkgarden or "Big Vein" is more extensively developed in the Georges Creek basin, especially in the vicinity of Frostburg, than in West Virginia, where it derives its name. The "Big Vein" varies in thickness from 5 to 7 feet up to more than 20 feet, the latter thickness having, moreover, been exceeded at one or two isolated points where pockets of unusual thickness have been reached. Its usual thickness is from 10 to 12 feet, and in general it has been found to thicken southward. The coal is very clean and of the highest quality, affording a low percentage of both ash and sulphur. It is in most respects the finest steam coal known and is extensively used where the highest grade coals are demanded.

The Elkgarden coal occurs at the base of the Monongahela formation, and is probably the equivalent of the Pittsburgh vein of Pennsylvania and West Virginia, although on account of the structural conditions under which it is found it differs materially from the latter in its physical and chemical properties.

Thin, persistent bands of slate or dry partings subdivide the "Big Vein" coal into three definite members, each of which possesses special characteristics. These beds are known as Roof coal, Breast coal, and Bottom coal.

The Roof coal includes several more or less important layers of coal of varying purity and thickness, separated by thin beds of shale. Except in the northern part of the basin these roof coals are not removed in mining, since they are of particular importance as a support for the overlying strata.

The Breast coal is the thickest and the most valuable member of the "Big Vein" coal. North of Frostburg it seems to retain its purity through a thickness of scarcely more than 2 feet, while south of Lonaconing it is sometimes more than 7 feet thick and without impurities. Near the top there is a 2 to 8 inch layer of bony coal, but this is rarely sufficiently impure to necessitate its rejection. Near the bottom there is a

<sup>a</sup> Clark, W. B., and others, *The mineral resources of Allegany County: Rept. Maryland Geol. Survey, 1900, pp. 177-178.*

4 to 6 inch band of soft "mining ply," which is jet black, has a brilliant luster, and shows a strong tendency to break into small cubical blocks.

The Bottom coal is  $2\frac{1}{2}$  to 3 feet thick and generally contains two thin slate bands. Other impurities are sometimes present, but they are seldom of a very serious nature. On account of the slate bands the bottom coal for many years was not mined, but under an improved system of mining these thin slates are now easily removed and the coal readily taken up.

The Davis (6-foot coal bed) is one of the most important of the small-vein coals of the State. The report <sup>a</sup> describes it as follows:

Near Westernport, where the seam approaches 6 feet in thickness, the coal has been mined for a number of years, and although seldom put upon the market as a competitor of the "Big Vein" coal, it has nevertheless supplied a considerable part of the demand in Westernport and Piedmont and is now finding a wider market.

Throughout the lower Georges Creek Valley the Davis coal reaches a greater thickness and is more important than any other coal except the "Big Vein." This coal always contains partings of either shale or sandstone, while bone-coal is not infrequent. There is at times considerable sulphur in the lower bench. At some points in the lower Georges Creek Valley the Davis vein is quite clean and, in general, seems to improve in quality southward. The Davis vein in Allegany County generally has a roof composed of shale, overlain by heavy sandstone. The Davis coal is situated about 125-150 feet above the base of the Allegany formation. This vein is generally regarded as the approximate equivalent of the lower Kittanning coal of Pennsylvania.

The Thomas (3-foot coal) varies in thickness from 2 feet 6 inches to 3 feet 2 inches. The coal is clean and has been successfully opened north of Westernport. The bed has a characteristic shale roof and a fire-clay floor. The coal is generally regarded as the equivalent of the Upper Freeport.

#### MINING METHODS.

The earliest records of the production of coal in Maryland are for 1820, during which year 3,000 tons of coal was mined. The production has generally increased until in 1913, 4,779,839 tons was mined. Most of the Maryland mines are worked by the room-and-pillar method from drift entries, there being only a few slope mines. Tail-rope haulage is used to some extent, whereas mule haulage is used extensively. There are relatively few mining machines in use and these are of the pick or puncher type. In 1900 there were 10 machines in operation, producing 138,014 tons, or 3.4 per cent of the coal mined in the State. In 1904 the machine-mined coal amounted to 10 per cent of the total production. In 1913, 91.5 per cent of the coal was mined by hand, 1.7 per cent by machine, and 6.2 per cent was reported as being shot off the solid. Although the greater part of the Maryland production is mined by hand, the record of individual efficiency of the miners is high. The average production of each man in 1913 was 847 tons, or 3.42 tons for each working day.

<sup>a</sup> Clark, W. B., and others, *op. cit.*, p. 173.

## REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

An act approved March 30, 1876, authorized the governor to appoint a mine inspector for Allegany and Garrett counties whose duty it was to inspect every coal mine at least once each month. When notified by the coroner of either county, the inspector was required to attend inquests and to investigate the causes of fatal accidents at the mines. Annual reports were rendered to the governor and all mine accidents were enumerated therein. On March 24, 1902, a law was approved extending the inspection service to include clay and fire-clay mines, and directing the inspector to examine all mines as often as possible, but at least once every two months. All fatal and serious accidents in and about the mines were required to be reported to the inspector by mine operators.

It is the practice of the operators to report all accidents to the inspector, and all accidents thus reported are published in the inspector's annual reports. Injuries causing less than 7 days' disability are considered as slight.

Up to 1915 the mine inspector employed no deputy or assistant inspectors.

## ACCIDENTS.

Tables 105 and 106 show the number of fatalities and men employed from the beginning of inspection service, 1876, to date, as compiled from the State mine inspectors' reports. The fatality rate for the years for which continuous records are available, 1889 to

FATALITIES IN **MARYLAND** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1889 TO 1913, INCLUSIVE. <sup>a</sup>

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	127	57.73	1.08
Mine cars and locomotives.....	30	13.64	.26
Gas and dust explosions.....			
Explosives.....	5	2.27	.04
Miscellaneous.....	36	16.36	.30
Shaft.....			
Surface.....	22	10.00	.19
Total, 23 years.....	220	100.00	1.87

<sup>a</sup> Excludes 1907 and 1908, for which the report for the fiscal year ending Apr. 30, 1908, was not available.

COAL-MINE ACCIDENTS IN **MARYLAND** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.....1909, Jan. 25.  
 Name of mine.....Washington No. 5.  
 Location of mine.....Franklin.  
 Nature of accident.....Mine cars.  
 Number killed.....5.



1906 and 1909 to 1913, inclusive, covering 23 years, is 1.87 per 1,000 men employed. The amount of coal produced per fatality was 459,193 tons, or there were 2.18 fatalities per million tons mined. During this 23-year period 220 men were killed, of which number 57.73 per cent was due to falls of roof and 13.64 per cent to mine cars and locomotives. Maryland has been remarkably free from gas and dust explosions; the fatality rate from explosives is also low, representing only 2.27 per cent of the total number killed.

The 10-hour day prevails in Maryland and for comparison with data on 8 and 9 hour States Tables 40 and 41 have been compiled. The fatality rate for the 8-year period 1903 to 1906, and 1910 to 1913,

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **MARYLAND.**<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	1	45			29	3,808	2,006	5,859
1904.....	2	72	6	974	43	4,531	94	5,671
1905.....	2	70	2	60	39	5,385	433	5,948
1906.....			1	50	45	6,358	30	6,438
1907.....			5	84	57	5,693	103	5,880
1908.....	1	80	3	59	49	5,905	35	6,079
1909 <sup>b</sup> .....								8,004
1910.....	3	9	6	71	61	5,717	12	5,809
1911.....	2	8	9	148	59	5,670	253	6,079
1912.....	2	53	4	41	57	6,000	68	6,162
1913.....	3	15	5	203	49	5,105	322	5,645

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **MARYLAND** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	219	56,494	12,372,186	6,186	12	1.94
1904.....	226	55,498	12,542,548	6,271	10	1.59
1905.....	252	58,847	14,829,444	7,415	15	2.02
1906.....	250	64,300	16,075,000	8,038	6	.75
1907.....	263	58,613	15,415,219	7,708		
1908.....	220	60,536	13,317,920	6,659		
1909.....						
1910.....	270	57,989	15,657,030	7,829	18	2.30
1911.....	243	60,373	14,670,639	7,335	15	2.05
1912.....	259	61,405	15,903,895	7,952	15	1.89
1913.....	248	55,895	13,861,960	6,931	13	1.88

inclusive, based on the actual number of employees is 2.18, whereas if reduced to the basis of 2,000-hour workers, the rate becomes 1.79. The number of hours worked per year per man in the coal mines of Maryland is 2,428, as compared with 1,620 in Michigan and 2,034 in

the bituminous mines of Pennsylvania and 2,132 in West Virginia. The tables of statistics for the State of Maryland follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN  
**MARYLAND.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	35	420	12	1907.....	510	13,770	27
1900.....	4,787	504,544	105	1908.....			
1901.....				1909.....	25	175	7
1902.....				1910.....			
1903.....	120	6,045	50	1911.....			
1904.....				1912.....	347	3,228	9
1905.....				1913.....	200	400	2
1906.....	30	300	10	1914.....	91	1,547	17

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.











## MICHIGAN.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal-bearing area of Michigan comprises about 11,000 square miles and occupies a basin in the central part of the lower peninsula between Lake Huron and Lake Michigan. The field extends from Jackson County on the south to Roscommon County on the north and from Tuscola County on the east to Kent County on the west. The principal mining operations are in Bay and Saginaw Counties in the northeastern part of the field.

### CHARACTER OF COAL BEDS.

The structure of the field is a comparatively flat basin modified by minor undulations. There are at least seven coal-bearing horizons in which coal may be considered as workable at certain places. The three principal coal beds are the Upper and Lower Verne and the Saginaw. The Upper and Lower Verne beds usually are close together and in a number of places are mined as one bed of coal. These beds vary in thickness from place to place, but the thickness of a single bed is not generally more than 3 feet. The combined thickness of the two beds within 10 feet of strata may be 7 feet. These coal beds are more or less undulating and in one instance a rise of 22 feet within 150 feet without faulting has been noted. In consequence of this irregularity many of the working plans of the mines in which the workings follow troughs are very irregular, and as most of the merchantable coal is less than 4 feet, some being less than 2 feet thick, large areas of this coal are left untouched. They are 100 to 150 feet below the surface. The Saginaw bed is somewhat deeper.

### MINING METHODS.

The records for coal production for Michigan began in 1860, when 2,320 tons of coal were mined. The production in 1913 was 1,231,786 tons. Practically all of the mines are opened by shafts 100 to 150 feet deep. The room-and-pillar system of mining is the principal method in use. The longwall method was tried at one or two mines but it was abandoned for the reason that there was too much danger of shattering the roof and letting in water from the glacial overburden. Mining machines were first introduced in Michigan in the Bay City district and became an important feature in Michigan mines in 1899, when 25 machines produced slightly over 10 per cent of the coal. In 1913, 70 per cent of the coal was produced by machines and 29.5 per cent shot off the solid.



## REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The legislature of Michigan, by an act approved May 2, 1899, authorized the commissioner of labor to appoint an inspector of coal mines, the inspector to examine all coal mines in the State and to report, from time to time, the results of his examinations to the commissioner of labor. The results of the inspector's examinations were incorporated in the regular annual report of the commissioner. The inspector was authorized to enter any coal mine at any time for the purpose of inspection or to collect statistics relating to "hours of labor, wages, industrial, economic and sanitary questions or matters, scales and oils." It was specified in an act approved May 10, 1905, that the law applied to "any shaft in process of sinking, and any opening projected for the purpose of mining coal." On June 2, 1909, a law was approved directing the commissioner of labor, under whose supervision the inspection of coal mines was carried on, to include in his annual reports beginning April 1, 1910, a statement showing the number of persons employed and the number and character of accidents in all departments of labor in the State.

All mine accidents are reported to the inspector and are published in his annual report to the commissioner of labor. Serious and slight injuries are neither segregated nor defined.

In 1915 the inspector employed no assistants.

## ACCIDENTS.

Tables 107 and 108 show the total number of fatalities by calendar years and causes from 1899 to 1913, inclusive, as compiled from the State mine inspector's reports. Beginning with 1900 to and including 1913, for which continuous records are available, 98 men were killed,

FATALITIES IN MICHIGAN COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1900 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	51	52.04	1.13
Mine cars and locomotives.....	2	2.04	.04
Gas and dust explosions.....	0		
Explosives.....	15	15.31	.33
Miscellaneous.....	15	15.31	.33
Shaft.....	10	10.20	.22
Surface.....	5	5.10	.11
Total, 14 years.....	98	100.00	2.16

representing a fatality rate of 2.16 per 1,000 men employed. Of the total number of fatalities 52.04 per cent was due to falls of roof-and-

pillar coal, 15.31 per cent to explosives, and 10.20 per cent to shaft accidents. Michigan has been fortunate in the matter of mine disasters, none having occurred in which 5 or more men were killed at one time. No fatalities are reported as due to gas and dust explosions. The average production per fatality during the 14-year period above referred to was 200,919 tons, or 4.98 fatalities per million tons mined.

Since 1905 practically all of the men employed in and about the mines of Michigan have been on an 8-hour basis. This, to a certain extent, accounts for the low fatality rate compared with other States, in which the men are employed 9 or 10 hours. The average number of hours worked per year per man in Michigan was 1,620

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN MICHIGAN.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	9	1,233	.....	.....	.....	.....	1,535	2,768
1904.....	20	2,627	.....	.....	.....	.....	922	3,549
1905.....	23	3,327	.....	.....	.....	.....	369	3,696
1906.....	27	3,941	.....	.....	.....	.....	30	3,971
1907.....	27	3,939	.....	.....	.....	.....	43	3,982
1908.....	31	4,224	.....	.....	.....	.....	23	4,247
1909 <sup>b</sup> .....	.....	.....	.....	.....	.....	.....	.....	3,496
1910.....	27	3,511	.....	.....	.....	.....	64	3,575
1911.....	21	3,199	.....	.....	.....	.....	49	3,248
1912.....	20	3,107	.....	.....	.....	.....	6	3,113
1913.....	24	3,305	.....	.....	.....	.....	.....	3,305

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN MICHIGAN AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000 hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	222	23,679	5,256,738	2,629	8	3.04
1904.....	183	29,314	5,364,462	2,682	6	2.24
1905.....	186	29,937	5,568,282	2,784	9	3.23
1906.....	173	31,798	5,501,054	2,751	5	1.82
1907.....	234	31,899	7,464,366	3,732	7	1.88
1908.....	207	33,999	7,037,793	3,519	6	1.71
1909.....	.....	.....	.....	.....	.....	.....
1910.....	211	28,664	6,048,104	3,024	6	1.98
1911.....	218	26,033	5,675,194	2,838	7	2.47
1912.....	183	24,910	4,558,530	2,280	8	3.51
1913.....	188	26,440	4,970,720	2,486	3	1.21

during the 10-year period, 1903-1913, as compared with 2,172 in Colorado or 2,034 in Pennsylvania (bituminous) and 2,447 in Virginia. The fatality rate (Table 40) based on the actual number of

men employed, is 1.83 for the 10-year period, as compared with 2.26 based on the 2,000-hour workers. Table 41 shows the fatality rates for a period of 10 years based on the 2,000-hour year for all the States, so that by referring to this table a true comparison of Michigan with other States may be seen. The tables of statistics for the State of Michigan follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN MICHIGAN.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	487	9,547	20	1907.....	265	1,325	5
1900.....	81	1,514	19	1908.....	300	4,800	16
1901.....				1909.....	527	23,002	44
1902.....	1,935	239,146	124	1910.....	1,663	86,789	52
1903.....	75	825	11	1911.....			
1904.....	564	2,402	4	1912.....	2,028	101,424	50
1905.....				1913.....	180	1,260	7
1906.....	3,340	294,630	88	1914.....			

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 107.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN MICHIGAN, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 and items above horizontal line in column 2 from State mine inspectors' report. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1860-1888.....	1,435,711																				
1889.....	67,431	\$1.71	261																		
1890.....	74,977	1.99	180				(a)	229	417	1.82											
1891.....	80,307	1.66	223				205	360	1.76												
1892.....	77,990	1.56	230				195	339	1.74												
1893.....	45,979	1.79	162				134	284	1.84												
1894.....	70,022	1.47	223				224	314	1.40												
1895.....	112,322	1.60	320				186	351	1.89												
1896.....	92,882	1.62	320				157	290	1.85												
1897.....	223,392	1.46	537				230	416	1.81												
1898.....	315,722	1.47	715				245	442	1.80		0.5										
1899.....	624,708	1.39	1,291	4			232	484	2.09		10.2			17	8					7	
1900.....	849,475	1.48	1,704	10	5.87	11.77	84,948	261	499	1.91	22.6									25	
1901.....	1,241,241	1.41	2,276	6	2.64	4.83	206,874	247	545	2.21	14.3									33	
1902.....	964,718	1.71	2,344	8	3.41	8.29	120,590	171	412	2.41	20.3									58	
1903.....	1,367,619	1.97	2,768	8	2.89	5.85	170,952	222	494	2.23	13.2									46	
1904.....	1,342,840	1.81	3,549	6	1.69	4.47	223,807	183	378	2.07	23.1			46	1					85	
1905.....	1,473,211	1.71	3,695	9	2.44	6.11	163,680	186	399	2.15	29.3			84	16					106	
1906.....	1,346,338	1.80	3,971	5	1.26	3.71	269,268	173	339	1.96	31.0			90	22					110	
1907.....	2,035,858	1.80	3,982	7	1.76	3.44	290,837	234	511	2.18	29.8			60	42					103	
1908.....	1,835,019	1.81	4,247	6	1.41	3.27	305,837	207	432	2.09	28.7			85	33					120	
1909.....	1,784,692	1.79	3,496	9	2.57	5.04	198,299	(a)	510	(a)	28.7			66	34					101	
1910.....	1,534,967	1.91	3,575	6	1.63	3.91	255,828	211	429	2.03	45.5			51	42					100	
1911.....	1,476,074	1.89	3,248	7	2.16	4.74	210,868	218	454	2.08	10.7	49.8	37.2	60	46					113	



1912.....	1,208,280	1.99	3,113	8	2.57	6.63	150,779	183	387	2.11	10.0	52.7	36.7	.6	48	37	41	128	22
1913.....	1,231,788	1.99	3,305	3	.91	2.44	410,395	188	373	1.98	.2	70.0	29.5	.3	26	38	66	120	26
Total.....	22,911,711			102															
Average (1900-1913).....	1,406,433	.....	3,234	7	2.16	4.98	200,919	204	435	2.13									
1914.....	1,283,030	2.00	2,800	2	.71	1.56	641,515	201	458	2.28	.2	77.8	21.9	.1	17	18	72	107	19

a Not reported.

TABLE 108.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN MICHIGAN, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1899 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1899 <sup>a</sup> .....	1					6						4	4													4
1900.....																	1		1						1	10
1901.....																										6
1902.....																										8
1903.....																										8
1904 <sup>b</sup> .....																										8
1905.....																										5
1906.....																										6
1907.....																										6
1908.....																										6
1909.....																										6
1910.....																										6
1911.....																										6
1912.....		1																								7
1913.....																										8
1914.....																										8

<sup>a</sup> June 1 to Dec. 1.<sup>b</sup> Cases of fatalities, 1901 to 1909, inclusive, not given in official reports. Classification here given based on description of each individual accident as published in local newspapers. The totals are from inspectors' reports.

## MISSOURI.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The productive coal area of Missouri comprises much of the northern half of the State, and a strip on the western border. It extends north into Iowa and west into Kansas. As in Iowa, the terms Des Moines and Missouri groups are applied to the upper and lower coal-bearing measures, respectively, both of which are in the Pennsylvanian series of the Carboniferous system. The Des Moines, which includes nearly all the coal beds of present economic importance, outcrops in about 16,000 square miles and also underlies the Missouri group in about 8,000 square miles.

### CHARACTER OF COAL BEDS.

In the north-central part of the State the coal beds are horizontal; in the western and northwestern part they dip northwest about 8 feet per mile.

The Missouri coal is low-grade bituminous, and more than 90 per cent is produced from the Des Moines group. The Bevier field in the north-central part of the State produces about 30 per cent of the coal from a bed varying 3 feet to 6 feet in thickness. The roof is sandy shale and sandstone of only moderate stability. The bed in the Lexington field is 14 to 26 inches thick and produces 25 to 30 per cent of the coal. The roof is a black, slaty shale with a strong limestone cap rock and is almost ideal for longwall mining.

The Southwestern field includes Henry, Barton, and Bates counties and produces about 20 per cent of the coal from a coal bed 3 to 4 feet thick. In these counties there are a few open-pit mines. The Novinger field (Adair County) produces about 10 per cent of the coal from a bed that is about  $3\frac{1}{2}$  feet thick. There are several smaller fields in other parts of the State.

### MINING METHODS.

The earliest statistics of coal production for Missouri date back to 1840, when 9,972 tons of coal were produced. The production for 1913 was 4,318,125 tons.

In 1912 there were about 214 mines in operation of which 136 were opened by shaft, 36 by slope, 25 by drift, and 7 were strip pits. Of this number 102 used the longwall method, and 94 the room-and-pillar method of mining. The longwall method is used almost exclusively in the Lexington field, where the coal is thin and has a good roof. In the other fields various forms of room and pillar methods are used. Electric haulage is used in 13 mines; mule haulage in 94, and hand haulage in 41 mines. Fifty-eight mines were ventilated by natural draft, 52 by furnaces, and 88 by fans. Hoisting at 80 mines was by steam power, at 3 by electricity, at 64 by horsepower, and at 5 by hand power.

Mining machines have been used in Missouri since 1896, when 4 machines were operated, producing 2.6 per cent of the coal. The number of machines has gradually increased until in 1913 there were 104 machines producing 20 per cent of the coal. It is reported that 46.8 per cent is shot off the solid, and 23.6 per cent is mined by hand.

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The first mine-inspection service of Missouri was provided for by the act approved March 23, 1881, authorizing the court of every county where coal mines were situated to appoint a county mine inspector. It was made the duty of mine operators to report to the inspector, under penalty, all fatal and serious accidents at their mines, and, if the accident was fatal, it was to be reported to the county coroner, or, in his absence or inability to act, to any justice of the peace in the county. If deemed necessary from the facts reported, the inspector was required to go to the scene of the accident, render assistance, investigate the cause of the accident, and preserve a record of his investigation with the other records of his office. The county inspectors rendered annual reports to the "Commissioner of Labor Statistics," showing causes of accidents, number employed in and about the mines, etc.

The law of March 30, 1887, consolidated the inspection service under the jurisdiction of a State mine inspector appointed by the governor on the recommendation of a board of examiners. The inspector thus appointed rendered annual reports on October 15 to the bureau of labor statistics.

The act of April 26, 1899, created a bureau of mines, mining, and mine inspection, and authorized the appointment of two mine inspectors—one for coal mines and the other for lead and zinc mines—the inspectors being given authority to appoint a secretary. The act of March 27, 1901, required the inspector to report to the governor by April 15 of each year. An assistant inspector was authorized by the act of March 30, 1907. The coal-mine inspection force was increased by the act of March 25, 1913, which authorized the appointment of a chief inspector and two assistants inspectors, the chief inspector to render annual reports to the governor on January 1 in accordance with existing laws.

It has not been definitely determined in Missouri when an injury is sufficiently serious to come within the requirement of the law that it shall be reported to the inspector, but it is the practice of the operators to report all injuries causing three or four days' disability, and these are published in the inspector's annual reports. Of the injuries reported to the inspector, those resulting in disability of an employee for at least 30 days are classified as serious, all others being considered slight injuries.



## ACCIDENTS.

The number of accidents in the coal mines of Missouri, by causes and calendar years, is contained in Tables 109 and 110. These tables also show the total number and percentage of fatalities classified by principal causes, and the fatality rate per 1,000 men employed for a period of 26 years (1888-1913), for which continuous records are

FATALITIES IN **MISSOURI** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1888 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	235	62.17	1.10
Mine cars and locomotives.....	19	5.03	.09
Gas and dust explosions.....	40	10.58	.19
Explosives.....	43	11.38	.20
Miscellaneous.....	10	2.64	.05
Shaft.....	27	7.14	.13
Surface.....	4	1.06	.02
Total, 26 years.....	378	100.00	1.78

COAL-MINE ACCIDENTS IN **MISSOURI** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1888 Mar. 29.....	Keith and Perry No. 6.	Rich Hill.....	Mine explosion.....	24
1915 Feb. 18.....	Atlas.....	.....do.....	.....do.....	5

available. The fatality rate during this period is 1.78 per 1,000 men employed. During the 26 years there was only one serious mine disaster, in which more than 5 men were killed at one time. This was a mine explosion in 1888 in which 24 men were killed, representing slightly over 6 per cent of the total number of fatalities during the period covered. Falls of roof and pillar coal are responsible for 62.17 per cent; gas and dust explosions, 10.58 per cent; and explosives, 11.38 per cent. The average production of coal per fatality was 229,541, or there were 4.36 fatalities per million tons of coal mined.

About 97 per cent of the men employed in the coal mines of Missouri since 1903 have been eight-hour men. As there are a number of States in which men are employed 9 or 10 hours per day, the time element has been taken into consideration, and tables compiled on this basis for comparison with other States. The fatality rate for the 10-year period 1903-1913 (Table 40), based on the actual number of men employed, is 1.30 per 1,000, and on the number of 2,000-hour workers is 1.70. During the 10-year period the men averaged 1,539 hours per year as compared with 2,463 hours in New Mexico, 2,132



NUMBER OF HOURS TO THE WORKING-DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **MISSOURI.**<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	191	9, 119	8	51	7	52	322	9, 544
1904.....	198	9, 686	10	72	8	65	314	10, 137
1905.....	194	8, 096	6	70	4	25	771	8, 962
1906.....	134	8, 645	6	58	6	80	774	9, 557
1907.....	149	8, 079	6	54			315	8, 448
1908.....	149	8, 464	10	83			441	8, 988
1909 <sup>b</sup> .....								9, 188
1910.....	166	9, 027	10	100	1	17	547	9, 691
1911.....	193	9, 523	8	84				9, 607
1912.....	172	9, 139	5	72	3	17	476	9, 704
1913.....	179	10, 200	4	79			139	10, 418

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.      <sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **MISSOURI** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	215	76, 829	16, 518, 235	8, 259	17	2. 06
1904.....	206	81, 612	16, 812, 072	8, 406	11	1. 31
1905.....	194	72, 587	14, 081, 878	7, 041	11	1. 56
1906.....	185	77, 448	14, 327, 880	7, 164	16	2. 23
1907.....	214	67, 953	14, 541, 942	7, 271	8	1. 10
1908.....	169	72, 428	12, 240, 332	6, 120	10	1. 63
1909.....						
1910.....	154	78, 209	12, 044, 186	6, 022	14	2. 32
1911.....	182	76, 940	14, 003, 080	7, 002	8	1. 14
1912.....	206	78, 214	16, 112, 084	8, 056	19	2. 36
1913.....	187	83, 562	15, 626, 094	7, 813	10	1. 28

in West Virginia, and 1,704 in Iowa. Table 41 shows the fatality rate for each year on the 2,000-hour basis for each State, so that a true comparison of Missouri with other States may be easily made. The tables of statistics for the State of Missouri follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **MISSOURI.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	2, 197	117, 076	53	1907.....	777	8, 222	11
1900.....	632	34, 970	55	1908.....	6, 350	355, 138	56
1901.....	1, 042	31, 318	30	1909.....	957	6, 593	7
1902.....	1, 364	61, 273	45	1910.....	7, 774	1, 218, 599	157
1903.....	1, 306	13, 892	11	1911.....	504	24, 216	48
1904.....	1, 844	26, 312	14	1912.....	952	55, 022	58
1905.....	435	6, 788	16	1913.....	918	31, 251	34
1906.....	6, 212	483, 790	78	1914.....	1, 162	56, 536	49

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.



1909.....	3,756,530	1.65	9,188	21	2.29	5.59	173,882	(a)	409	(a)	21.2	.....	.....	.....	4	18	74	.....	98	224
1910.....	2,982,433	1.79	9,691	14	1.44	4.69	213,031	154	308	2.00	18.6	.....	.....	.....	23	73	73	.....	96	208
1911.....	3,836,107	1.72	9,607	8	.83	2.09	479,513	182	399	2.19	19.9	19.6	49.4	11.1	17	75	75	.....	92	232
1912.....	4,336,596	1.76	9,704	19	1.96	4.38	228,413	206	447	2.17	23.9	20.7	48.0	7.4	2	78	78	.....	86	217
1913.....	4,318,123	1.73	10,418	10	.96	2.32	431,813	187	414	2.21	23.6	20.0	46.8	9.6	7	80	80	.....	104	208
Total.....	120,168,472	.....	.....	378	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average (1888-1913).....	3,337,180	.....	8,185	14.54	1.78	4.36	229,541	195	408	2.09	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1914.....	3,935,980	1.73	9,549	19	1.99	4.83	207,157	179	412	2.30	22.2	19.0	46.6	12.2	2	1	79	6	88	178

a Not reported.

TABLE 110.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN MISSOURI, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1887 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.
1888 <sup>a</sup> .....	6	1	1		24	1						3	27	1					1						27
1889 <sup>a</sup> .....	10	1	1	1		4							15	1		1			1						18
1890 <sup>b</sup> .....	10	2	1	1		3	1						17	1		3			1						20
1891.....	12	1	1	3		2							20	1		1			1						22
1892.....	13	2	1			1							19	1		1			1						18
1893.....	13	1	1			1							17	1		1			1						18
1894.....	10	1	1	4		1	1						17	1		1			1						19
1895.....	6					5							12	1		1			1						13
1896.....	7	1	1			1							10	1		2			1						8
1897.....	9	1	1			1							9						1						12
1898.....	7					1							11						1						10
1899.....	8	1	1		2								18			1									11
1900.....	16					1							16												19
1901.....	10	1	1	3		5							18	1		1									16
1902.....	5		1			3							8	1		1			2						10
1903.....	10		1			3							17			1			2						17
1904.....	8					3							11						1						11
1905.....	7	1				2							10	1	1				2						11
1906.....	12					2							14	1	1				1						16
1907.....	6		1			1							8						2						8
1908.....	8	1	1	1									10						3						10
1909.....	10	4				4							18	1		2			3						21
1910.....	8		3			1						2	14			1			3						14
1911.....	6	1											7						3						8
1912.....	7	2	2	2	1			2					16	1		2			3						19
1913.....	8					1						1	10			5			5						10
1914.....	12		2										14						5						19

<sup>a</sup> Fiscal year ending Oct. 15.<sup>b</sup> Includes Oct. 15 to Dec. 31, 1889, making 14½ months.



**MONTANA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal fields of Montana are widely distributed over the eastern two-thirds of the State, and have an aggregate area of about 39,000 square miles. From a commercial standpoint there are only three important fields in the State. These are, according to production, as follows: (1) Red Lodge field in Carbon County, (2) Bull Mountain field in Musselshell County, and (3) the Great Falls field in Cascade County.

The Red Lodge field comprises an area of about 50 square miles, but the number and thickness of the beds compensate in large measure for the small size of the field. The beds dip to the southwest toward the Beartooth Mountain, from which they are separated by a great fault.

The Bull Mountain field has a known productive area of 630 square miles, being a great synclinal basin lying mainly between Yellowstone and Musselshell rivers. This field has developed since the building of the Chicago, Milwaukee & St. Paul Railway in 1908.

The Great Falls coal field, which contains about 1,500 square miles, is south and east of the town of Great Falls. This field is one of the first to be developed in the State, but owing to the heavy percentage of ash the coal can hardly compete with that from Red Lodge and Bull Mountain.

The Milk River field, in the northern part of the State, as well as the great lignite fields in the eastern part, cover large areas, but are only slightly developed.

**CHARACTER OF COAL BEDS.**

The coal beds of the Red Lodge field vary from 3 to 12 feet in thickness; the coal is high-grade subbituminous, slacks readily, and for this reason pillars will soon crush when left standing, and thus allow the roof to fall. The coal about Bridger, a little to the northeast of Red Lodge, is bituminous, but only a little of this coal is mined at present.

In the Bull Mountain field the coal beds occupy a synclinal trough. There are 10 to 16 feet of clean coal; the dip does not exceed 6°. The mines are opened by shafts ranging from 137 to 350 feet deep. The quality of the coal is about the same as that mined in the Red Lodge field.

In the Great Falls field the beds are 3 to 7½ feet thick, with a slight dip to the north. At Sand Coulee, the principal mining center of this field, the beds are flat and about 10 feet thick. The coal is bituminous and intrinsically of higher grade than from either of

the fields so far described, but the heavy percentage of ash detracts greatly from its commercial value, and the field, which up to 1907 held first place in the State's production, has now dropped to third place.

In the Milk River field the roof in most cases is a soft sandstone or carbonaceous shale, making it necessary to leave considerable coal to keep the entries from caving in. Extensive timbering will be necessary when mining is done on a large scale.

#### MINING METHODS.

The mines at Chestnut, Gallatin County, are the oldest in the State, having been opened in 1867, and coal hauled from them long distances by teams. The records show that the production of coal in Montana began in 1880, when 224 tons were reported as mined. In 1913 the production was 3,240,973 tons, of which Carbon County mined 1,187,270 tons. The mines are opened by drift, slope, and shaft, and are mined by the room-and-pillar and pillar-and-stall systems. At Stockett the roof is sandstone, and the coal is mined by machines. Machines are also extensively used at Belt. In 1896 there were 62 mining machines in use in the State, which produced 37.5 per cent of the coal; in 1913 there were 97 machines, producing 33.2 per cent of the coal, whereas 35 per cent was shot off the solid, and 31 per cent was reported as being mined by hand.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The first mine-inspection law of Montana was approved March 14, 1889, and provided for the inspection of all mines where 5 or more men were employed, except mines operated only by the owners or lessees. The inspector was authorized to employ an assistant to act in cases of emergency, as in cases of accidents, or in the absence of the inspector. The assistant's salary was on a per diem basis and his employment was limited to 100 days a year. Mine operators were required to report to the inspector or his deputy all fatal and serious accidents in and about the mines. The inspector was required, whenever possible, to go to the scene of the accident and investigate the cause thereof; and if it was not possible for the inspector to visit the mine, the person in charge was required to obtain written and sworn statements from persons who had witnessed the accident. The inspector rendered annual reports to the governor and enumerated therein all accidents of which he had received notice.

On March 4, 1897, an act was approved directing the deputy inspector to devote his entire time to his official duties. On March 18, 1901, an act relating exclusively to coal mines was approved, and

the governor was authorized to appoint a coal-mine inspector. An act approved March 4, 1913, created a department of labor and industry, consisting of a commissioner, boiler inspector, inspector of mines, and coal-mine inspector, and directed that the annual reports of these inspectors should be combined in one volume and published biennially. The authority to appoint the deputy inspector was transferred from the coal-mine inspector to the governor by an act approved March 31, 1913.

Mine operators in Montana report to the inspector only those accidents causing at least 14 days' disability, and these are published in the inspector's annual reports. Accidents causing disability for less than 14 days are not considered serious.

### ACCIDENTS.

Tables 111 and 112 show the number of fatalities in and about the coal mines in Montana, classified by causes and calendar years since 1889, as compiled from the State mine inspector's reports. The years 1896 and 1899 are left blank, as reports for these years were not available. Continuous records for 1900 to 1913, inclusive, show that 159 men were killed in and about the coal mines in Montana,

FATALITIES IN MONTANA COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1900 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	88	55.34	2.15
Mine cars and locomotives.....	23	14.47	.56
Gas and dust explosions.....			
Explosives.....	11	6.92	.27
Miscellaneous.....	27	16.98	.66
Shaft.....	1	.63	.02
Surface.....	9	5.66	.23
Total, 14 years.....	159	100.00	3.89

COAL-MINE ACCIDENTS IN MONTANA IN WHICH 5 OR MORE MEN WERE KILLED

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1906 June 7.....	Red Lodge.....	Red Lodge.....	Mine fire.....	8
1908 Nov. 20.....	do.....	do.....	do.....	9

representing a fatality rate of 3.89 per 1,000 men employed. Of this number 55.34 per cent were killed by falls of roof and pillar coal and 14.47 by mine cars and locomotives. Montana has been free from disasters due to gas and dust explosions. The production per fatality was 186,276, or there were 5.37 fatalities per million tons of coal



mined. There have been two mine fires, in which 17 men were killed.

The 8-hour day prevails in Montana and the time element is, therefore, taken into consideration for comparison with other 8-hour and with 10-hour States (Table 40). The total number of hours worked per year is 1,930, as compared with 2,447 for Virginia or

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN MONTANA.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	13	449	5	1,635	1	3	68	2,155
1904.....	19	646	8	1,653	4	12	194	2,505
1905.....	23	b 1,707	.....	.....	2	6	468	2,181
1906.....	28	b 2,203	1	85	.....	.....	106	2,394
1907.....	29	2,732	1	3	.....	.....	.....	2,735
1908.....	36	2,903	1	2	.....	.....	241	3,146
1909 c.....	.....	.....	.....	.....	.....	.....	.....	4,535
1910.....	44	3,568	.....	.....	1	.....	263	3,837
1911.....	44	3,862	.....	.....	.....	.....	2	3,854
1912.....	39	3,435	.....	.....	1	5	.....	3,440
1913.....	40	3,416	1	4	.....	.....	210	3,630

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Including day men who work 10 hours.

<sup>c</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN MONTANA AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	254	18,949	4,813,046	2,407	5	2.08
1904.....	243	21,911	5,324,373	2,662	.....	3.38
1905.....	243	17,928	4,356,504	2,178	8	3.67
1906.....	243	19,343	4,700,349	2,350	13	5.53
1907.....	268	21,883	5,864,644	2,932	13	4.43
1908.....	224	25,411	5,692,064	2,846	21	7.38
1909.....	.....	.....	.....	.....	.....	.....
1910.....	239	30,971	7,402,069	3,701	12	3.24
1911.....	220	30,914	6,801,080	3,401	14	4.12
1912.....	220	27,530	6,056,600	3,028	7	2.31
1913.....	228	29,254	6,669,912	3,335	20	6.00

2,255 for Alabama. The total number of hours of labor performed has been converted to a 2,000-hour basis and fatality rates shown in Table 41, for comparison with other States. The fatality rate on the actual number of men employed during the 10-year period 1903 to 1913 (except 1909) is 4.08, as compared with 4.23 fatalities per 1,000 on the basis of 2,000-hour workers. The tables of statistics for the State of Montana follow:



STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN  
MONTANA.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	650	33,800	52	1907.....	30	600	20
1900.....	40	1,640	41	1908.....	556	9,201	17
1901.....	285	14,175	49	1909.....	110	1,110	10
1902.....	686	7,636	11	1910.....	345	38,260	111
1903.....				1911.....	529	8,114	15
1904.....	792	37,140	47	1912.....	869	8,445	10
1905.....	200	36,000	180	1913.....	1,094	6,682	6
1906.....	200	7,000	31	1914.....	171	1,271	7

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE III.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN MONTANA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 compiled from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10 prior to 1900 calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.				Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.	Per year.			Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
1880-88.....	303,350																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</

1911.....	2,976,358	1.79	3,964	14	3.62	4.70	212,597	220	770	3.50	25.7	39.4	39.4	1.0	56	18	11	2	87	49
1912.....	2,048,405	1.82	3,440	7	2.03	2.50	495,491	220	886	4.03	20.3	32.3	36.9	.5	38	21	8	2	69	49
1913.....	3,240,973	1.74	3,630	20	5.51	6.17	102,019	228	893	3.92	31.0	37.2	33.3	.5	53	22	19	3	97	43
Total.....	41,400,039			204																
Average (1900-1913).....	2,115,567		2,921	11.36	3.89	5.37	188,276	239	724	3.03										
1914.....	2,805,173	1.75	3,350	8	2.39	2.85	350,647	209	837	4.00	24.2	41.3	31.9	.6	57	21	20	1	99	44

a Not reported.

b Figures in italics represent incomplete fatality records.

TABLE 112.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN MONTANA, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1890 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.		
	Total.										Total.						Total.								
	Falls of rock, etc. (coal,	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.		Other causes.	Total.
1889.....	1	2	3	4	5	6	7	8	9	10	11	12							17	18	19	20	21	22	
1890.....	1	1	1																						
1891.....	1	1	2			1																			
1892.....	1	1	2																						
1893.....	1	1																							
1894.....	4			1		2			1																
1895 <sup>a</sup> .....	4																								
1896 <sup>b</sup> .....	3		5			1																			
1897.....	3	4																							
1898 <sup>a</sup> .....	1	1	3			1																			
1899.....	1	3	1			2																			
1900.....	1	1	1																						
1901.....	4	1	1			1															1				1
1902.....	4	1	1																						
1903.....	3	1	1																						
1904.....	1	1	1																						
1905.....	3	1	1																						
1906.....	3	1	1					1			8														
1907.....	3	1	1			1					9									2		1			
1908.....	4	1	1																						
1909.....	4	1	1																						
1910.....	4	1	1																						
1911.....	4	1	1																						
1912.....	2	1	1																						
1913.....	6	1	1			2																			
1914.....	2	1	1			2																2			1

<sup>a</sup> 11 months.<sup>b</sup> No report.<sup>c</sup> Figures in italics represent incomplete fatality records.



## NEW MEXICO.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal fields of New Mexico comprise about 13,000 square miles but most of this large area is undeveloped and the producing districts are small and widely scattered.

The most important field, both as regards quality of coal and amount produced, is the Raton field, which is the southward continuation of the Trinidad field of Colorado. It extends about 40 miles south of the State line to the Cimarron River, and from the base of the Rocky Mountain Range eastward about 50 miles. Its area is about 960 square miles.

The largest area is the San Juan River region in the northwestern corner of the State. Its area is about 10,000 square miles, but only two small districts in this great field are developed at present. These are Gallup, on the Santa Fe Railroad, at the southern end of the field, and Monero, or Lumberton, at the north end. The coal at Gallup is subbituminous, and at Monero bituminous. The Los Cerillos field, in the central part of Santa Fe County, contains about 35 square miles, and is noteworthy as the only western field outside of Colorado that is producing anthracite. Operations in the White Oaks field of Lincoln County are small, and the production is limited to local consumption. Mining on a small scale is also carried on at Carthage, in Socorro County, in a small isolated field containing bituminous coking coal.

### CHARACTER OF COAL BEDS.

Practically all of the coal mined in the Raton field comes from a few large mines working the lowest bed of coal. This bed varies from 4 to 12 feet thick. There are at least four other coal beds thick enough to be of economic importance, although comparatively little development has been done on them. The second bed from the bottom, known as the Sugarite coal, has been opened east of Raton at the Sugarite mine, and the third bed has been developed to some extent at Yankee, and is believed by some to be the same as the coal bed opened at Brilliant, which is situated in Dillon Canyon, northwest of Raton. No producing mines have been opened on the higher coal beds. The coal beds in the Raton field lie nearly flat, and mining is not particularly dangerous, except for gas in some of the mines.

In the Gallup district the coal beds, as a rule, lie nearly flat, except on the rim of the basin, 3 miles east of Gallup, where they sharply upturn. There are five coal beds in this district, ranging in thickness from 2½ to 7 feet.

The coal beds of the Los Cerrillos field dip about  $18^{\circ}$  east. There are three important beds, varying in thickness from  $2\frac{1}{2}$  to 7 feet with the higher grade of coal in the northern part of the field. The northern part also contains some anthracite coal which has been produced by an intrusion of igneous rock, and which gradually merges into coking and semicoking coals to the south.

The only other field in which active mining is carried on is a few miles east of Socorro. This field contains coking coal, but the beds are so broken by faults and covered by recent material washed in from the surrounding higher land that mining is expensive and uncertain.

#### MINING METHODS.

The records of coal production in New Mexico extend back to 1882, during which year 157,092 tons of coal were produced. The production has gradually increased until in 1913 the total amount was 3,708,806 tons. In 1898 the 29 mining machines in use produced 16.5 per cent of all the coal mined. During 1905 and 1906 there were no mining machines in operation, but in 1907 three machines were introduced, and the number has gradually increased until in 1914 45 machines produced 16 per cent of the coal. In 1911 31.2 per cent of the coal was shot off the solid, but with the increase in the amount of machine-mined coal the amount shot off the solid was reduced to 17.6 per cent in 1913. From 65 per cent to 75 per cent of the coal is mined by hand.

The coal mines of New Mexico are operated on single and double entry systems through slopes and drifts. One large company operates a triple-entry system. Coal is mined by the room-and-pillar method. In 1913 there were three longwall mines and three panel-system mines. Many of the mines are very dry, and humidifiers have been installed. Shot firers are employed. Mule, horse, and electric haulage are in use. The following extracts<sup>a</sup> are from the State mine inspector's report for 1910.

The Tocco mine, near Albuquerque, has the distinction of operating the thinnest coal seam developed in New Mexico, one of the thinnest worked in the United States, and one that ranks also with the thinnest mined in Europe. The seam is from 12 to 15 inches thick, with 1 to 3 inches of bony coal at the top, leaving 10 to 13 inches of clean coal to be mined. A slope has been sunk 355 feet, with an average dip of  $25^{\circ}$ , and cross entries have been driven about 30 feet apart. The props used are from 10 to  $13\frac{1}{2}$  inches long. The coal is bituminous, free from sulphur, and is a good black-smith's coal. The product of the mine is hauled to Albuquerque, N. Mex., where it is sold for blacksmithing purposes at from \$9 to \$12 per ton of 2,000 pounds.

The mines at Dawson are worked as follows:

Triple main entry; double-cross entry; room-and-pillar, robbing on retreat. All main drift entries are 10 feet wide by 6 feet high; main cross entries, 8 feet by 6 feet.

<sup>a</sup> State mine inspector's report, 1910, pp. 17, 20.

Cross entries off cross entries are 8 feet wide by 5 feet 6 inches high; main air courses are 10 feet by 6 feet and other air courses 8 feet wide by 6 feet. All workings are substantially timbered and haulage ways and traveling roads are lighted by electricity. Main entry pillars are from 100 to 300 feet thick; main cross entry pillars, 50 to 100 feet. Average length of rooms, 350 feet; room centers, 60 feet; width of rooms, 20 feet; size of room pillars, 40 feet. The mines are ventilated by exhaust fans on the surface. Shots are fired by electricity after all persons are out of the mine.●

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

By an act of Congress approved March 3, 1891, official inspection of coal mines was authorized in all Territories where the aggregate annual production of such mines exceeded 1,000 tons. The appointment of the inspector was vested in the President of the United States. Under the provisions of this law, the first mine inspector for the Territory of New Mexico was appointed July 1, 1892, and entered upon duty August 30, 1892. Section 15 of the act provided that a full and written report of all fatal accidents should be made to the mine inspector within 10 days after such death shall have occurred. Annual reports for fiscal years ending June 30 were rendered to the Secretary of the Interior. New Mexico was admitted to the Union on January 6, 1912, and the former Territorial mine inspector was continued in office. The office of State mine inspector was created by an act approved June 13, 1912, and the first State inspector was appointed September 20, 1912. The State law requires mine operators to keep a record of all accidents at their mines, to which record the inspector shall have access, and to at once report to the inspector by telegraph or telephone all accidents resulting in death, such immediate report to be followed, within 10 days, by a full and complete written report of the accident. It was made the inspector's duty to proceed without delay to any mine within the State upon receipt of notice of any explosion or other accident resulting fatally or jeopardizing the lives of the men working in such mine. Annual reports are rendered to the governor for years ending November 30.

According to the State inspector, the number of nonfatal accidents published in his annual report is not complete, as the reporting of such accidents is not made compulsory by law, and some operators do not report all injuries at their mines.

In 1915 the State inspector had no clerical or other assistants.

#### **ACCIDENTS.**

Tables 113 and 114 show by causes and calendar years the total number of fatalities in and about the mines of New Mexico, since the beginning of inspection service in 1893 to the end of 1913, as compiled from the territorial and State mine inspectors' reports. The



21-year period from 1893 to 1913 shows 568 fatalities, of which 56.51 per cent was due to gas and dust explosions, 28.17 per cent to falls of roof and pillar coal, and 7.57 per cent to mine cars and locomotives. The fatality rate for New Mexico is exceedingly high by reason of the disaster at Dawson, in which 263 men were killed at one time.

FATALITIES IN **NEW MEXICO** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1893 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	160	28.17	3.22
Mine cars and locomotives.....	43	7.57	.87
Gas and dust explosions.....	321	56.51	6.46
Explosives.....	24	4.23	.48
Miscellaneous.....	16	2.82	.32
Shaft.....	0		
Surface.....	4	.70	.08
Total, 21 years.....	568	100.00	11.43

COAL-MINE ACCIDENTS IN **NEW MEXICO** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1895 Feb. 27.....	White Ash.....	Cerrillos.....	Mine explosion.....	24
1899 Apr. 21.....	Cook and White.....	Madrid.....	do.....	5
1903 June 19.....	Blossburg No. 3.....	Blossburg.....	do.....	5
1906 Oct. 5.....	Dutchman.....	do.....	do.....	10
1907 Dec. 31.....	Bernal.....	Carthage.....	do.....	11
1913 Oct. 22.....	Stag Canon No. 2.....	Dawson.....	do.....	263

The fatality rate during this period is 11.43 per 1,000 men employed. By referring to Table 40 it will be noted that the fatality rate for common accidents—that is, those in which less than 5 men were killed at one time—based on the actual number of employees is 4.84 per 1,000 men, for the 10-year period 1903 to 1913, inclusive, excepting 1909. The number of fatalities due to exceptional accidents—that is, those in which 5 or more men were killed at one time—is 9.70 for the same 10 years. The fatality rate due to common accidents is a little higher than in a number of other States. The one disaster at Dawson overshadows all others and for this reason the total rate is exceedingly high. Table 40 also shows that the number of hours worked per year per man is 2,463, as compared with 1,495 for Ohio and 2,034 for the bituminous mines of Pennsylvania. By reducing the fatality rate of common accidents to the basis of 2,000-hour workers, the rate becomes 3.93 as compared with 3.84 for Ohio and 2.82 for the bituminous mines of Pennsylvania.



NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN NEW MEXICO.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	7	99	1	3	13	1,309	378	1,789
1904.....	6	78	1	31	15	1,680	60	1,849
1905.....	4	83	5	92	12	1,923	10	2,108
1906.....	8	78	2	24	16	1,856	112	2,070
1907.....	8	79	4	287	14	2,584	20	2,970
1908.....	5	30	6	356	14	3,015	47	3,448
1909 <sup>a</sup> .....								3,317
1910.....	5	21	5	185	16	3,345	34	3,585
1911.....	2	5	6	167	22	3,516	12	3,700
1912.....	2	4	6	140	23	3,777	7	3,928
1913.....	16	2,335	8	401	10	1,590	3	4,329

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN NEW MEXICO AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day. (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	260	17,311	4,500,860	2,251	22	9.77
1904.....	228	18,243	4,159,404	2,080	8	3.85
1905.....	234	20,812	4,870,008	2,435	7	2.87
1906.....	242	20,408	4,938,736	2,469	23	9.32
1907.....	269	29,235	7,864,215	3,932	34	8.65
1908.....	197	34,017	6,701,349	3,351	24	7.16
1909.....						
1910.....	283	35,589	10,071,687	5,036	16	3.18
1911.....	230	36,811	8,466,530	4,233	11	2.60
1911 <sup>b</sup> .....	274	39,125	10,720,250	5,360	16	2.99
1913.....	289	38,216	11,044,424	5,522	272	49.26

From 1903 to the close of 1912 practically all of the men in the mines of New Mexico were employed on a 10-hour basis, but in 1913 the majority of the men were employed 8 hours a day. Table 41 shows the fatality rates on the 2,000-hour basis for a period of years, so that a comparison with other States may be easily made. The tables of statistics for the State of New Mexico follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN NEW MEXICO.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....				1904.....	556	73,090	131
1900.....				1905 to 1912.....			
1901.....	766	32,949	43	1913.....	8	1,040	130
1902.....	470	9,820	21	1914.....			
1903.....	54	710	13				

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 113.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN NEW MEXICO, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 and items above horizontal lines in columns 2 and 21 from State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reporting.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
1882-1888.	2,301,182																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

1912.....	3,536,824	1.42	3,928	16	4.07	4.52	221,052	274	900	3.28	74.7	8.1	16.9	.3	7	4	.....	13	1	25
1913.....	3,708,806	1.46	4,329	272	62.83	73.34	13,635	289	857	2.57	68.7	13.4	17.6	.3	7	6	.....	30	44	36
Total.....	41,406,006			568																
Average (1893-1913).....	1,771,859		2,366	27.05	11.43	15.27	65,509	242	749	3.10										
1914.....	3,877,689	1.61	4,178	18	4.31	4.64	215,427	283	928	3.28	65.0	16.0	18.8	.2	9	8	.....	28	45	35

a Not reported.

TABLE 114.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN NEW MEXICO, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1893 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.					Killed on surface.						Grand total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	Falls of rock, etc.,		Falls of face or pillar coal.		Mine cars and loco-motives.		Gas explosions and burning gas.		Coal-dust explosions (including gas and dust combined).		Explosives.		Suffocation from mine gases.		Electricity (shock or burns).		Animals.		Mining machines.		Mine fires (burned, suffocated, etc.).		Other causes.		Total.		Falling down shafts or slopes.		Objects falling down shafts or slopes.		Cages or skips.		Other causes.		Total.		Mine cars and mine locomotives.		Electricity (shock or burns).		Machinery.		Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.		Other causes.		Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
	1	2	3	4	5	6	7	8	9	10	11	12	Total.		13	14	15	16	Total.		17		18	19	20	21	22	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
1893.....	2	1		1		1							4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

a Stag Canyon explosion, killed 263.



**NORTH CAROLINA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal-bearing formations of North Carolina are contained in the Deep River and the Dan River fields and are of Triassic age. The Deep River field extends from the northern boundary in a southwesterly direction through Durham, Haywood, and Wadesboro, entirely across the State and a short distance into South Carolina. The field averages about 12 miles wide and contains 250 to 300 square miles. The Deep River coal is bituminous and in some places has been more or less coked by igneous intrusions.

**CHARACTER OF COAL BEDS.**

The coal beds dip about 15° southeast and vary from 1 foot to 8 feet in thickness. Mining has been conducted in this field in a desultory way since the early sixties. From 1860 to 1865 it is estimated that about 65,000 tons of coal was produced. One of the most important mines worked in recent years is the Cumnock, which is opened by a shaft 8 feet by 12 feet in cross section and 460 feet deep. This mine has been the scene of two serious mine explosions in which 62 men were killed.

The Dan River field consists of a small coal-bearing area in the north-central part of the State and is 50 or 60 miles northwest of the Deep River field. The Dan River field extends from the Virginia-North Carolina line in a southwesterly direction and is about 30 miles long and 4 to 7 miles wide. The coal beds are 2 to 7 feet thick and dip about 34°. A small amount of coal was mined from this field during the Civil War, but since that time little mining has been done there.

Tables 115 and 116 give further details concerning the number of men employed, coal produced, accidents, etc. These tables are meager and incomplete, but contain all the data available.

**REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

There is official mine-inspection service<sup>a</sup> in North Carolina, but as the State is not a regular producer of coal, the occasional output is too small to place the industry on a commercial scale. The tables of statistics for this State follow.

**COAL-MINE ACCIDENTS IN NORTH CAROLINA IN WHICH 5 OR MORE MEN WERE KILLED.**

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1895 Dec. 19.....	Cumnock.....	Cumnock.....	Mine explosion.....	39
1899 May 23.....	do.....	do.....	do.....	23

<sup>a</sup> Revised Statutes, 1905, sec. 4940.

TABLE 115.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN NORTH CAROLINA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.<sup>a</sup>  
[Compiled from Mineral Resources, U. S. Geol. Survey.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reporting.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.	
1862-1887.	229,150						7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1888.	250																				
1889.	222																				
1890.	10,262	\$1.74	80					254	128												
1891.	20,355	1.93	80					254	254	1.00											
1892.	6,679	1.44	90					160	74	.46											
1893.	17,000	1.50	70					180	243	3.04											
1894.	16,900	1.76	95					145	178	1.23											
1895.	24,900	1.66	61	39				226	408	1.81											
1896.	7,813	1.50	18					220	434	1.97											
1897.	21,280	1.34	51					215	417	1.94											
1898.	11,465	1.25	(b)					(b)	(b)	(b)											
1899.	26,896	1.30	70	23				151	384	1.83											
1900.	17,734	1.32	84					210	211	1.40											
1901.	12,000	1.25	25					300	480	1.60											
1902.	23,000	1.50	40					285	575	2.02											
1903.	17,309	1.47	49					264	353	1.34											
1904.	7,000	1.50	25					240	280	1.17											
1905.	1,557	1.50	15					60	104	1.73											
1906.																					
1907.																					
1908.																					
1909.																					
1910.				0																	
1911.	120			0																	
1912.	200			0																	
1913.				0																	
Total.	477,125		Total.	62																	

<sup>a</sup> Figures in italics represent incomplete fatality records.

<sup>b</sup> No record.

## **NORTH DAKOTA.**

### **AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal beds of North Dakota are lignitic, and occupy about 35,000 square miles, or practically the western half of the State. Ninety-seven townships contain at least one bed of lignite 7 feet thick, and at least 100 other townships contain beds 4 to 7 feet thick. The lignite beds are horizontal and occur at depths ranging from near the surface to a depth of at least 300 feet.

### **MINING METHODS.**

Lignite has been mined in North Dakota by ranchers and others since the territorial days of the State, and the first records of production were obtained in 1884, when 35,000 tons of coal was mined.

The production in 1913 was 495,322 tons.

In 1911 there were practically 100 mines in operation, 20 of which were surface and 80 underground mines. Of the underground mines, 69 were opened by slope or drift and 11 by shaft. The mines are opened by single and double entry and the coal mined by the room-and-pillar method, the rooms being 12 by 100 feet to 22 by 300 feet; pillars are 8 to 20 feet wide. The length of entries varies from 100 to 5,000 feet. In 1911, there were 15 mines with entries over 1,000 feet long. The largest number of deep mines is in Ward County, where the mines vary from surface pits to 200 feet in depth; 21 mines are over 100 feet deep. In Adams County the deepest mine in 1911 was 300 feet.

Ventilation is usually by an air shaft in connection with slope, drift, or entry.

Mining machines have been in use in a limited way since 1896. In 1914 there were 14 machines in operation, producing 41.1 per cent of the coal mined. Twenty-six per cent was shot off the solid and 6.3 per cent was mined by hand.

### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The State engineer of North Dakota was made ex-officio State coal-mine inspector by an act approved March 14, 1907, with power to employ necessary assistants. The engineer renders biennial reports to the governor, showing the condition of each mine, number of men employed, and such other information as he deems desirable.

The law does not require operators to notify the inspector of mine accidents, but the inspector has requested the operators to report all accidents, however slight. All accidents thus reported are published in the biennial reports of the inspector. No distinction is made between serious and slight injuries.



## ACCIDENTS.

Tables 116 and 117 show the total number of fatalities in and about the coal mines of North Dakota from 1908 to the end of 1913, as compiled from the State mine inspectors' reports. During the 6-year period 1908 to 1913, inclusive, there were 13 fatalities, of which 46.16

FATALITIES IN **NORTH DAKOTA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1908 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 em- ployed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	11	46.16	1.44
Mine cars and locomotives.....	2	15.38	.48
Gas and dust explosions.....			
Explosives.....	3	23.08	.72
Miscellaneous.....	2	15.38	.48
Shaft.....			
Surface.....			
Total, 6 years.....	13	100.00	3.12

per cent were due to falls of rock, 23.08 per cent to explosives, and 15.38 per cent to mine cars and locomotives. The production per fatality during this period was 203,020 tons, or there were 4.93 fatalities per million tons mined. North Dakota has been fortunate in that there have been no serious mine disasters in that State. The fatality rate during this period is 3.12 per 1,000 men employed.

Since 1903 practically one-half of the men have been employed on a 10-hour basis. By referring to Table 40 it will be noted that during this period the men averaged 1,974 hours per year. During the

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **NORTH DAKOTA**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men em- ployed other than 8, 9, and 10 hours per day.	Total number of men em- ployed.
	Number of mines.	Men em- ployed.	Number of mines.	Men em- ployed.	Number of mines.	Men em- ployed.		
1903.....	6	40	8	90	20	263	93	486
1904.....	8	66	11	117	20	292	79	554
1905.....	8	79	7	50	20	374	123	628
1906.....	6	47	4	38	20	323	80	488
1907.....	11	89	6	119	17	304	50	562
1908.....	11	103	5	114	14	275	139	631
1909 <sup>b</sup> .....								972
1910.....	11	94	6	75	16	327	38	534
1911.....	12	115	4	46	24	423	176	760
1912.....	12	59	4	51	23	415	97	622
1913.....	13	61	5	51	24	472	57	641

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.<sup>b</sup> Census year.



NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **NORTH DAKOTA** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	198	4,597	910,206	455		
1904.....	192	5,212	1,000,704	501		
1905.....	187	5,929	1,108,723	555		
1906.....	209	4,668	975,612	488		
1907.....	223	5,273	1,175,879	588		
1908.....	181	5,851	1,059,031	530	4	7.55
1909.....						
1910.....	207	5,039	1,043,073	522	2	3.83
1911.....	229	7,148	1,636,892	818	1	1.22
1912.....	232	5,954	1,381,328	691		
1913.....	221	6,180	1,365,780	683	6	8.78

5-year period 1908 to 1913 (exclusive of 1909) for which complete data are available, the fatality rate based on the actual number of employees is 4.08 as compared with 4.01 based on the number of 2,000-hour workers. Table 41 shows the figures on the 2,000-hour basis for a period of years by States, so that a comparison with other States may be readily made.

The tables for the State of North Dakota follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **NORTH DAKOTA.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....				1907.....	82	736	9
1900.....				1908.....	104	1,620	16
1901.....	32	224	7	1909.....	75	525	7
1902.....	8	8	1	1910.....			
1903.....	35	340	10	1911.....	34	69	2
1904.....	175	6,300	36	1912.....	10	20	2
1905.....				1913.....			
1906.....	37	92	2	1914.....			

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 116.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN NORTH DAKOTA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures for column 4 compiled from State mine inspectors' reports. Figures for columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.

[illegible]



**OHIO.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal-bearing area of Ohio covers about 12,600 square miles, and occupies 30 counties in the southeastern part of the State. It is a part of the northwestern side of the great Appalachian coal basin which stretches from northern Pennsylvania to central Alabama. As it lies on the northwestern side of the basin the general dip of the beds is southeast toward the middle, but there are a few small folds which break up the continuity of the southeastward dip, and in some places cause a dip in the opposite direction. The most pronounced fold of this kind trends north to south and enters the State near Marietta. The coal beds and associated rocks extend to the northeast into West Virginia and Pennsylvania and to the southwest into Kentucky.

**CHARACTER OF COAL BEDS.**

The coal beds of Ohio are numbered from the bottom upward, coal No. 1 being the lowest bed. Coal No. 1 has been most extensively developed in the northern part of the State, but it occurs in isolated areas along the west side of the field. It is from 3 to 6 feet thick at Brier Hill and at Massillon. The roof is shale ranging from 5 to 40 feet in thickness. The coal is jointed, hence its name, block coal. It is noncoking, but of good steaming quality. The No. 2, or Wellston bed, is 45 to 75 feet above No. 1 and is seldom more than 2 feet thick, although at Wellston, Jackson county, it is 4 feet thick. The roof is shale and the coal non-coking.

The No. 5 bed, or Lower Kittanning, extends in an almost unbroken outcrop across the State. It is mined in almost every county of the Ohio coal field from southern Mahoning on the north to Hanging Rock on the south. It is generally less than 3 feet thick, but at Mineral Point, Zanesville, and New Castle, it is 4 to 5 feet thick. The coal is of good coking quality, but because of the thinness of the bed mining machines are not used extensively, the coal being largely mined by pick mining.

No. 6 bed, or the Middle Kittanning, also extends under a wide area. In the northern part of Columbiana County it is less than 1 foot thick. In the southern part of the county it is worked extensively, although it is only 20 to 30 inches thick. In Coshocton County, it attains a thickness of 3 feet to 4 feet 10 inches. At Shawnee it is known as the Hocking Valley seam, and in many places contains 10 feet of mineable coal. From 32 to 38 per cent of the State's production comes from this bed.



The No. 7, or Upper Freeport, is not so extensive as the lower beds and varies in thickness from 5 feet 4 inches to 6 feet 9 inches. This is one of the best steaming coals in the State.

The No. 8, or Pittsburgh, is the most important bed of the upper coal measures. The coal rests on a bed of fire clay and is 4 to 6 feet thick. This bed extends into West Virginia and into Pennsylvania.

#### MINING METHODS.

The accompanying table shows the number of mines opened by shaft, slope or drift, from 1892 to 1912, inclusive. At first the single-entry system of mining prevailed, but in the early eighties the double-entry system was introduced in a number of the larger mines, and now, although the single-entry system still prevails in some mines where the bed is thin, most of the mines are opened by the double-entry system, also some are opened by the three-entry system.

Mining machines are used extensively in coal beds Nos. 6, 7, and 8. Prior to 1877 all of the coal mined in Ohio was mined by pick. During this year the first mining machines were introduced in the State and the use of machines has steadily increased until in 1913 there were 1,681 machines in operation, producing 21,535 tons each, or in all 90.2 per cent of the coal of the State. The electric machines were introduced in Ohio in 1889 and their number has gradually increased to 1,604 in 1913. In 1891, 89 compressed-air machines were in use in Ohio mines and in 1905 the highest number, 145, was reached. There were only 49 in operation in 1913. Less than 4 per cent of the coal is reported as being shot off the solid, and slightly over 4 per cent as being mined by hand.

Prior to the introduction of mining machines in Ohio, the coal-mining work was performed principally by skilled miners from England, Scotland, and Germany. This class of miners has gradually been supplanted in the State by labor from southern Europe. The table on methods of opening and ventilation at Ohio mines follows:

NUMBER OF COAL MINES IN OHIO, CLASSIFIED BY TYPE OF OPENING AND METHOD OF VENTILATION FROM 1892 TO 1913, INCLUSIVE.<sup>a</sup>

Year.	Mines opened by—					Method of ventilation.						
	Drift.	Shaft.	Slope.	Small mines, kind of opening unknown.	Total.	Fan.	Furnace.	Fire baskets.	Steam jets and exhaust from pumps.	Natural.	Small mines, mode of ventilation unknown.	Total.
1892.....	303	91	40	458	892	127	253	11	30	205	266	892
1893.....	676	121	61	151	1,009	141	323	23	39	316	167	1,009
1894.....	657	149	61	296	1,163	139	264	32	43	378	309	1,165
1895.....	749	150	68	220	1,187	134	278	36	48	452	242	1,190
1896.....	821	149	66	167	1,203	134	281	38	52	528	179	1,212
1897.....	800	153	85	190	1,228	149	280	51	49	516	200	1,245
1898.....	921	143	145	46	1,255	149	317	45	47	636	73	1,267
1899.....	789	145	133	65	1,132	147	274	41	34	523	107	1,126
1900.....	696	122	140	114	1,072	171	264	48	33	453	103	1,072
1901.....	625	133	149	99	1,006	182	253	40	44	389	98	1,006
1902.....	589	140	142	96	967	219	222	57	45	336	88	967
1903.....	591	142	140	81	954	259	244	44	32	302	73	954
1904.....	638	153	142	85	1,018	282	254	50	34	320	78	1,018
1905.....	626	130	125	.....	881	289	239	36	13	304	.....	881
1906.....	696	163	144	.....	1,003	299	252	38	13	401	.....	1,003
1907.....	691	140	149	.....	980	322	235	37	19	367	.....	980
1908.....	742	140	171	.....	1,053	314	236	46	14	443	.....	1,053
1909.....	744	130	158	.....	1,032	302	240	42	19	429	.....	1,032
1910.....	726	110	147	.....	983	318	225	35	14	391	.....	983
1911.....	702	114	132	.....	948	345	191	26	14	372	.....	948
1912.....	703	113	125	.....	941	350	195	30	11	355	.....	941
1913.....	707	109	128	.....	944	355	187	35	14	353	.....	944

<sup>a</sup> State mine inspector's reports.

## REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

By an act approved March 21, 1874, the Legislature of Ohio provided for the inspection of all coal mines in which more than 10 men were employed at one time. Under this act the first State inspector was appointed April 6, 1874, and entered upon his duties the following day. The act made it the duty of any person having charge of any mine to which the law was applicable to report forthwith to the State inspector and the county coroner any explosion or other accident causing loss of life. The inspector was required to render a report to the governor on or before the 1st day of January of each year, and to enumerate therein, among other things, all accidents in or about the mines.

On April 12, 1884, the State was divided into three districts, and the enforcement of the laws relating to mining was intrusted to a chief mine inspector and three district inspectors. The inspection service was also extended to include fire-clay, iron-ore, and other mines, as well as coal mines. The number of districts and district inspectors was increased by statute from time to time, until in 1913 there were 12 districts, each having an inspector. On March 12, 1913 a law was passed, and approved March 18, 1913, discontinuing

various State departments and offices, among them being the office of chief mine inspector, and transferring all powers and duties of the inspector to a newly created State industrial commission. Under the provisions of this law, the new commission assumed the duties and functions of the chief inspector of mines on September 1, 1913, and established the office of chief deputy and safety commissioner of mines.

All accidents are reported to district inspectors and are included in the annual reports of the industrial commission. Injuries involving disability for three weeks or more are classified as serious, and all other injuries are slight.

### ACCIDENTS.

Tables 118 and 119 show the total number of fatalities by causes since the beginning of inspection service in 1874 with the exception of the fiscal year 1879, for which no report was published. These tables also show the percentage of accidents, classified by principal causes, and fatality rates per 1,000 men employed for a period of 30

FATALITIES IN **OHIO** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1884 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	1,509	65.84	1.57
Mine cars and locomotives.....	277	12.08	.29
Gas and dust explosions.....	64	2.79	.07
Explosives.....	161	7.02	.17
Miscellaneous.....	115	5.02	.12
Shaft.....	79	3.45	.08
Surface.....	86	3.80	.09
Total, 30 years.....	2,292	100.00	2.39

COAL-MINE ACCIDENTS IN **OHIO** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1877 July 11.....	Brookfield.....	Brookfield.....	Suffocated by gas from mine locomotive.....	7
1881 Feb. 10.....	Robbins.....	Robbins.....	Mine explosion.....	6
1906 Nov. 3.....	San Toy No. 1.....	Corning.....	Fell down shaft.....	5
1910 Apr. 21.....	Amsterdam.....	Amsterdam.....	Mine explosion.....	15
1913 May 17.....	Imperial.....	Belle Valley.....	do.....	15

years (1884-1913), for which complete records of employees and fatalities are available. The fatality rate during this period is 2.39 per 1,000 men employed. Ohio has been fortunate in the matter of large disasters, there being only 3 during this period causing the death of more than 5 men at one time, representing only 1½ per cent



of the total number killed. Falls of roof and pillar are responsible for 65.84 per cent of the fatalities; mine cars and locomotives are second with 12.08 per cent. The average production of coal per fatality during this period was 251,152 tons, or 3.98 fatalities for each million tons mined.

Since 1903 more than 97 per cent of the men employed in the mines have been on an 8-hour day. The time element, therefore, has been taken into consideration and tables compiled on this basis for comparison with other States. The fatality rate for the 10-year

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN OHIO.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, and 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	538	39,876	15	455	14	206	1,399	41,936
1904.....	574	42,845	9	296	7	77	416	43,634
1905.....	524	42,262	7	527	4	27	583	43,399
1906.....	461	44,003	8	174	3	76	1,185	45,438
1907.....	490	44,733	4	53	2	31	2,016	46,833
1908.....	510	45,742	8	1,004	3	35	626	47,407
1909 <sup>b</sup> .....								38,114
1910.....	587	45,001	12	249	1	5	1,386	46,641
1911.....	566	44,351	7	378	3	8	722	45,459
1912.....	581	44,180	11	474	1	10	863	45,527
1913.....	604	45,487	8	187	3	32	109	45,815

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN OHIO AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	194	337,754	65,524,276	32,762	124	3.78
1904.....	175	349,938	61,239,150	30,620	117	3.82
1905.....	176	348,356	61,310,656	30,655	126	4.11
1906.....	167	365,015	60,957,505	30,479	131	4.30
1907.....	199	376,795	74,982,205	37,491	154	4.11
1908.....	161	380,956	61,333,916	30,667	113	3.68
1909.....						
1910.....	203	374,773	76,078,919	38,039	159	4.18
1911.....	179	364,788	65,297,052	32,649	107	3.28
1912.....	201	365,573	73,480,173	36,740	135	3.67
1913.....	206	366,880	75,577,280	37,789	165	4.37

period 1903 to 1913 (Table 40) based upon the actual number of employees is 2.94, whereas based on the number of 2,000-hour workers it is 3.94. During the 10-year period the men averaged 1,495 hours of labor per man, as compared with 2,132 hours in West Virginia, and 2,034 hours in the bituminous mines of Pennsylvania. Table 41 shows the fatality rate for each year on the 2,000-hour



basis for each State, so that a true comparison of Ohio with other States may be readily made. The tables of statistics for the State follow.

## STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN OHIO.

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	877	26,394	30	1907.....	6,367	110,324	17
1900.....	2,035	45,547	22	1908.....	21,084	567,450	27
1901.....	2,724	105,177	38	1909.....	2,375	139,434	59
1902.....	3,769	70,534	19	1910.....	24,746	1,334,631	54
1903.....	4,115	65,149	16	1911.....	9,530	350,039	37
1904.....	11,412	514,658	45	1912.....	27,200	895,777	32
1905.....	3,250	49,495	15	1913.....	10,029	263,234	26
1906.....	37,936	2,687,288	71	1914.....	40,577	6,452,762	159

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.











**OKLAHOMA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal fields of Oklahoma have an area of about 10,000 square miles. In general the rocks of these fields dip slightly west under the Great Plains, but in Oklahoma the regular westward dip is interfered with by many local folds. On this basis the coal fields of the State may be divided into two parts as follows: (1) that part north of Canadian River in which the rocks are only slightly disturbed, and (2) the part south of Canadian River in which there are many strong anticlines and synclines that make the coal beds dip in various directions and at different angles. The part north of Canadian River is the southward continuation of the Kansas fields, but with the coal beds in greatly reduced thickness. The part south of Canadian River is similar to and a continuation of the folded and faulted fields of Arkansas. Local faults occur in the McAlester anticline near McAlester.

On the northern slope of the McAlester anticline the coal-bearing rocks are tilted until the coal beds are almost vertical, and from Hartshorne to Atoka the beds are also steeply upturned. In this respect the Oklahoma coal fields are similar to those of Washington, certain parts of Colorado, and the anthracite fields of Pennsylvania. They differ from the coal fields of Washington in that the coal has not been crushed or changed in character by structural movement of the inclosing rocks.

The southern part of the coal field is the more important, as more than three-fourths of the coal mined in 1913 came from that section. The larger part of an area embracing Craig, Rogers, Tulsa, Wagoner, Okmulgee, Muskogee, McIntosh, Haskell, Sequoyah, Le Flore, Coal, Latimer, and Pittsburg counties, all in the eastern part of the State, is known to contain coal.

**CHARACTER OF COAL BEDS.**

There are seven coal beds in this field that are thick enough to be worked on a commercial scale. There are, however, two groups of beds from which most of the coal mined in the southern part of the field has been obtained. These are the Hartshorne coal beds, generally two in number, at the top of the Hartshorne sandstone, and the two McAlester coal beds near the top of the McAlester shale, and from 1,500 to 1,800 feet above the Hartshorne group. The Hartshorne beds are in places about 50 feet apart, and in other places they meet. West of Wilburton the upper bed is absent. The lower bed is 4 to 5 feet thick and the upper one is about  $4\frac{1}{2}$  feet thick. East

of Wilburton there are two beds about  $2\frac{1}{2}$  feet thick in the McAlester group; but about Hartshorne, McAlester, and Savanna there is only one bed, which ranges in thickness from 3 to 5 feet.

The Henryetta field in Okmulgee county was recently opened. It contains a bed of coal averaging 3 feet in thickness, and lying practically horizontal at depths varying from 100 to 200 feet, and is worked mostly by machines. The coal is not as good as other Oklahoma coals but serves as a good steam and railroad fuel, and can be produced more cheaply than the other coals to the south of Okmulgee County. Two important mining towns, Henryetta and Dewar, have recently been built as a result of the development of this coal field. The Henryetta coal field, unlike the southern coal fields, is not on segregated lands. The coal beds in Pittsburg, Coal, Latimer, and Le Flore counties and part of Haskell County, are on segregated coal lands belonging to the Choctaw and Chickasaw Indian Nations.

#### MINING METHODS.

The earliest records of coal production in Oklahoma are for 1880, when 120,947 tons of coal was produced. The production in 1913 was 4,165,770 tons. About 60 per cent of the mines are opened by slopes and drifts with lengths on the incline varying from 50 to 3,500 feet. The shaft mines number about one-third of the mines in the State, and vary in depth from 70 to 800 feet. The coal is mined entirely by the room-and-pillar method. Some of the mines are quite gaseous, and much dust is produced in mining.

In 1896 there were 56 mining machines in operation, which produced 14 per cent of the coal mined in the State. In 1898, there were 75, which produced 19.9 per cent of the coal. The use of mining machines gradually declined until in 1907 there were only 11 machines in operation, producing less than 1 per cent. Since that date, the number of machines has gradually increased until in 1913, there were 103 machines in operation, producing 16.1 per cent of the coal.

Shooting off the solid is practiced to such an extent in Oklahoma that in 1912, 86.4 per cent of the coal was thus produced. This proportion, however, was by the increase of machines in 1913 reduced to 80.9 per cent. The laws of the State compel the payment of wages on the basis of run-of-mine, hence a tendency to encourage the practice of shooting from the solid. Holes are usually drilled 6 to 10 feet deep, and sometimes as much as 14 feet with no undercutting nor channeling. Sufficient powder is charged to break the coal with the result that much fine coal is produced. In some instances

these long holes are charged with dynamite. Dust is scattered throughout the mine, the roof is loosened more or less, and at least 15 per cent of the coal shot down is thrown into the gob and lost. This method of mining produces unsafe conditions in the mine in addition to being wasteful, as much of the coal is so badly crushed that it is unfit for commercial uses.

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The act of Congress establishing a mine-inspection service in all Territories where the output of coal exceeded 1,000 tons annually was approved March 3, 1891. Under this act the first inspector in Indian Territory (now Oklahoma) entered on duty March 20, 1893. Mine operators were required to report to the inspector all cases of fatal accidents at their mines, such report to be in writing and made within 10 days after such death occurred. Annual reports for fiscal years ending June 30 were rendered to the Secretary of the Interior.

A State department of mines and mining was created by an act approved April 6, 1908, and under the provisions of this law the appointment of a chief mine inspector and three district inspectors was authorized, the inspectors to investigate all accidents, injuries, and deaths at mines. The first report of the State inspector covers the period from November 16, 1907, to October 31, 1908, and annual reports since the latter date have been issued for fiscal years ending October 31.

It has been the practice of mine operators to report to the inspector all fatal and serious accidents. Since the enactment of the compensation law, all accidents causing a disability of one day or more are reported. All accidents reported are included in the inspector's annual reports and are classified as fatal or nonfatal, but no distinction is made between serious and slight injuries.

In 1915 the inspection force consisted of one chief inspector and three deputy inspectors.

#### **ACCIDENTS.**

Tables 120 and 121 show the production of coal, number of men employed, and the number of fatalities in and about the coal mines of Oklahoma. The fatalities as tabulated have been compiled from the Territorial and State mine inspectors' records, and are complete from 1893 to and including 1913. During this period of 21 years, there were 729 fatalities representing a rate of 5.45 per 1,000 men employed.



FATALITIES IN **OKLAHOMA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1893 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	153	20.99	1.14
Mine cars and locomotives.....	78	10.70	.58
Gas and dust explosions.....	262	35.94	1.96
Explosives.....	115	15.77	.86
Miscellaneous.....	79	10.84	.59
Shaft.....	25	3.43	.19
Surface.....	17	2.33	.13
Total, 21 years.....	729	100.00	5.45

COAL-MINE ACCIDENTS IN **OKLAHOMA** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1892 Jan. 7.....	No. 11.....	Krebs.....	Mine explosion.....	100
1897 Jan. 4.....	No. 1.....	Alderson.....	do.....	5
1901 Apr. 29.....	McAlester No. 5.....	do.....	Blown-out or windy shot.....	6
1901 Dec. 28.....	No. 1.....	Hartshorne.....	Fell from cage.....	6
1902 Jan. 13.....	Milby and Dow.....	Dow.....	Mine fire.....	10
1903 Apr. 12.....	Central Slope 77.....	Carbon.....	Mine explosion.....	6
1905 Apr. 30.....	No. 19.....	Wilburton.....	do.....	13
1906 Jan. 24.....	Poteau No. 6.....	Witteville.....	Dynamite explosion.....	14
1908 Aug. 26.....	Hailey-Ola No. 1.....	Haileyville.....	Mine fire.....	29
1909 Oct. 21.....	Rock Island No. 8.....	Hartshorne.....	Mine explosion.....	10
1910 Mar. 31.....	Great Western No. 2.....	Wilburton.....	do.....	6
1912 Feb. 22.....	Western No. 5.....	Lehigh.....	Mine fire.....	9
1912 Mar. 20.....	San Bois No. 2.....	McCurtain.....	Mine explosion.....	73
1914 Sept. 4.....	No. 1.....	Adamson.....	Cave-in.....	13

The amount of coal produced per fatality during this period was 71,111 tons, or there were 14.06 fatalities per million tons mined. Of the total number of fatalities during this period 35.94 per cent was due to gas and dust explosions, 20.99 to falls of roof and coal, and 15.77 per cent to explosives. Mine cars and locomotives claim 10.70 per cent of the fatalities. Since the beginning of inspection service March 20, 1893, to and including 1913, there were 12 mine disasters in which 5 or more men were killed at one time, as shown in the accompanying list.

Since 1903, the majority of the employees at the coal mines in Oklahoma have been on an 8-hour basis. Fatalities have, therefore, been calculated on the basis of a 2,000-hour year, showing that the rate for Oklahoma on this basis is 6.81 for the period of 1903 to 1913, except 1909. This compares with 5.08 based on the number of actual employees for the same period. The number of hours worked per year per man is 1,406, as compared with 1,564 for Kansas, and 2,132 for West Virginia. The Oklahoma rate based on the actual number

# 272 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

## NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **OKLAHOMA**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, and 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	55	6,952	3	487	2	190	75	7,704
1904.....	59	8,251	2	95	2	75	66	8,437
1905.....	59	7,544	.....	.....	3	108	60	7,712
1906.....	70	7,824	3	167	4	81	179	8,251
1907.....	83	8,079	.....	.....	6	194	125	8,398
1908.....	64	8,258	.....	.....	4	118	275	8,651
1909 <sup>b</sup> .....	.....	.....	.....	.....	.....	.....	.....	8,689
1910.....	89	8,472	.....	.....	2	50	135	8,657
1911.....	90	8,247	.....	.....	3	35	447	8,729
1912.....	82	8,105	.....	.....	3	120	560	8,785
1913.....	87	8,725	.....	.....	2	109	210	9,044

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

## NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **OKLAHOMA** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	247	62,574	15,455,778	7,727	42	5.44
1904.....	199	68,207	13,573,193	6,786	29	4.27
1905.....	188	61,972	11,650,736	5,825	41	7.04
1906.....	166	66,516	11,041,656	5,521	44	7.97
1907.....	216	67,697	14,622,552	7,311	39	5.33
1908.....	172	69,719	11,991,668	5,996	46	7.67
1909 <sup>a</sup> .....	.....	.....	.....	.....	.....	.....
1910.....	144	69,491	10,006,704	5,003	39	7.80
1911.....	156	70,349	10,974,444	5,487	27	4.92
1912.....	174	71,080	12,367,920	6,184	99	16.01
1913.....	197	72,780	14,337,660	7,169	23	3.21

<sup>a</sup> Census year.

of employees appears to be slightly less than the fatality rate in West Virginia, but when reduced to the uniform basis of fatalities per 2,000-hour workers, the rate becomes 6.81 for Oklahoma, as compared with 5.18 for West Virginia. For comparative purposes, Tables 40 and 41 have been compiled so that it is an easy matter to compare Oklahoma with other States. The tables of statistics for the State of Oklahoma follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN  
OKLAHOMA.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	1,825	281,256	154	1907.....	669	17,092	26
1900.....	110	31,100	283	1908.....	6,929	398,251	57
1901.....				1909.....	1,576	11,368	7
1902.....	150	9,000	60	1910.....	8,213	1,247,828	152
1903.....	448	1,928	4	1911.....	444	15,106	34
1904.....	488	5,175	11	1912.....	860	12,109	14
1905.....	397	3,509	9	1913.....	1,696	135,274	80
1906.....	7,372	535,504	72	1914.....	1,286	39,500	31

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 120.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN OKLAHOMA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.<sup>a</sup>

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 compiled from Territorial and State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.					Number of mines.	
				Total.	Per 1,000 employed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.		Total.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1880-1887.	2,966,438	1.88	1,700																		
1888.	761,986	1.76	1,862						448												
1889.	752,832	1.76	1,862					(b)	404												
1890.	869,229	1.82	2,571					238	338	1.42											
1891.	1,091,032	1.74	2,891						377	1.70											
1892.	1,192,721	1.71	3,257					211	366	1.73											
1893.	1,252,110	1.79	3,446	6	1.74	4.79	208,685	171	363	2.12											
1894.	1,969,606	1.59	3,101	9	2.90	9.28	107,734	157	313	1.99											
1895.	1,211,185	1.43	3,212	9	2.80	7.43	134,576	164	377	2.30											
1896.	1,366,646	1.40	3,549	15	4.23	10.98	91,110	170	385	2.26		14.0									
1897.	1,336,380	1.34	3,168	28	8.84	20.95	47,728	176	422	2.40		19.7									
1898.	1,381,466	1.32	3,216	23	7.15	16.65	60,064	198	430	2.17		19.9									
1899.	1,537,427	1.43	4,084	28	6.86	18.21	54,908	212	376	1.77		18.0			52	16	6				
1900.	1,922,298	1.45	4,525	35	7.73	18.21	54,923	238	425	1.86		12.5									
1901.	2,421,781	1.62	6,706	57	8.50	23.54	67,159	268	361	1.74		7.3									
1902.	2,820,666	1.51	5,374	42	7.53	14.89	67,159	232	506	2.18		4.2									
1903.	3,517,388	1.82	7,704	42	5.45	11.94	83,747	247	457	1.85		2.1			16	18	2				
1904.	3,046,539	1.82	8,487	29	3.42	9.52	105,053	199	359	1.80		1.4			25	4					
1905.	2,924,427	1.76	7,712	41	5.32	14.02	71,357	188	379	2.02		1.4			18	11					
1906.	2,860,205	1.92	8,251	44	5.33	15.38	65,005	166	347	2.09		1.2			3		1				
1907.	3,642,658	2.04	8,398	39	4.64	10.71	93,401	216	434	2.01		1.7			15	2					
1908.	2,948,116	2.03	8,651	46	5.32	15.60	64,089	172	341	1.98		1.1			17	3					



1909.....	3,119,377	2.00	8,689	48	5.52	15.39	64,987	(b)	359	1.5	.....	28	4	2	.....	34	99
1910.....	2,646,226	2.22	8,657	39	4.51	14.74	67,852	144	305	1.1	.....	12	.....	1	.....	13	98
1911.....	3,074,242	2.05	8,729	27	3.09	8.78	113,861	156	352	2.8	78.8	5	6	5	8	26	112
1912.....	3,675,418	2.14	8,785	99	11.27	26.94	37,125	174	418	7.1	80.4	16	14	4	11	60	101
1913.....	4,165,770	2.05	9,014	23	2.54	5.52	181,120	197	461	2.2	80.9	35	13	.....	10	193	95
Total.....	59,474,164	.....	.....	829	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average 1893-1913.....	2,468,568	.....	6,366	34.71	5.45	14.06	71,111	191	388	2.0	70.7	29	8	20	37	116	9
1914.....	3,988,613	2.06	8,078	31	3.84	7.77	128,665	205	494	2.41	.....	.....	.....	.....	.....	.....	.....

<sup>a</sup> Oklahoma became a State in 1908. Figures for years previous refer to Indian Territory.

<sup>b</sup> Not reported.

<sup>c</sup> Figures in italics represent incomplete fatality records.



## OREGON.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal in Oregon is subbituminous. The Coos Bay field, which is the principal one in the State, occupies a small structural basin in the vicinity of Coos Bay and contains 230 square miles. It extends north and south and is about 30 miles long, with a maximum width of 11 miles. There are other coal fields in the State, but none of them has been worked to any extent, so do not enter into the question of mine accidents. The Coos Bay field may be divided into six parts, consisting of four basins and two arches. The basins containing workable coal are the Newport, Beaver Slough, Coquille, and South Slough. The arches contain no coal. The structure of these basins may be considered as simple, the dip being slight. There are a number of faults, but these are of little importance.

The Newport basin, the principal one that has been worked, contains about 6 feet of coal in three benches, yielding 5 feet of coal that can be mined. The roof is sandstone and requires comparatively little timbering. The top bench of coal is usually left with the upper parting to form the roof.

The Beaver Slough basin contains five beds, the most important being the lowest one, which contains over 6 feet of coal. This bed has been mined at Beaver Hill.

### MINING METHODS.

The first records of coal production for Oregon are for the year 1880, when 43,205 tons was reported. Three mines have been opened by drifts and slopes in the Newport basin, and the coal is mined by the room-and-pillar method. In the Beaver Slough basin one or two mines have been opened by slopes and a small amount of coal has been mined by the pillar-and-chute system.

### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

No provision has been made by the State of Oregon whereby accidents in or about coal mines shall be reported to a State official. The coal production of the State since 1880 has averaged less than 64,000 tons annually. Reports of accidents have, since 1910, been voluntarily rendered to the Federal Bureau of Mines by the mine operators at the close of each calendar year.

### ACCIDENTS.

The production of coal, number of men employed, and the number of fatalities, as far as complete records are available, are given in Tables 122 and 123. The fatalities at coal mines have been recorded

only since 1909, but the number of employees has been reported since 1890. For the five years for which continuous records are available, the accident rate in Oregon is comparatively low, being 2.69 per 1,000 men employed, but on the tonnage basis it is high, being 10.37 fatalities per million tons mined. There have been no serious coal-mine disasters in Oregon. The tables of statistics for the State follow:

FATALITIES IN **OREGON** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEAR  
1909 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	1	33.00	0.90
Mine cars and locomotives.....	2	67.00	1.79
Gas and dust explosions.....			
Explosives.....			
Miscellaneous.....			
Shaft.....			
Surface.....			
Total, 5 years.....	3	100.00	2.69

#### STRIKES AND LOCKOUTS.

During 1914, the first year in which there were labor troubles in Oregon, 21 men were on strike, resulting in the loss of 798 days, or an average of 38 days per man.



TABLE 122.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN OREGON, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.  
[Figures for total production and columns 2, 3, and 8 compiled from Mineral Resources, U. S. Geol. Survey. Figures in column 4 reported direct to the Bureau of Mines by the operators. Figures in columns 5, 6, 7, 9, and 10 calculated.]

Year.	Production (short-tons).	Value per ton at mine.	Number employed.	Number killed.				Production per death (short tons).	Days worked.	Average tonnage per man		Percentage coal mined by—						Number and kind of machines.						Number of mines.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
				Total.	Per 1,000 employed.	Per 1,000,000 tons mined.	Per year.			Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
1880-1889	468,860	2.89	208						305	296	0.97																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</

<sup>a</sup> Not reported.



**PENNSYLVANIA (ANTHRACITE).****AREA AND DISTRIBUTION OF COAL FIELDS.**

The anthracite coal fields of Pennsylvania occupy portions of Sullivan, Lackawanna, Luzerne, Carbon, Schuylkill, Dauphin, and Northumberland and Columbia counties in the northeastern part of the State. They comprise an area of 480 square miles, and form four distinct fields, as follows: The northern or Wyoming-Lackawanna field, in Luzerne and Lackawanna counties; eastern-middle or Lehigh field, in Luzerne and Carbon counties; southern or Schuylkill field, in Dauphin and Schuylkill counties; and western-middle field. A brief description of each field is given in the following paragraphs:

**CHARACTER OF COAL BEDS.**

The coal beds of the anthracite fields of Pennsylvania are described by Stoek <sup>a</sup> as follows:

**NORTHERN FIELD.**

From Forest City to Pittston and from Pittston to Nanticoke, north of the Susquehanna, the maximum dips are 10° to 20°, while between Pittston and Nanticoke, south of the Susquehanna, steeper dips, ranging from 60° to 70°, are found, and near Glen Lyon the measures are overturned and badly broken. There are numerous anticlines and synclines in the measures which can sometimes be traced on the surface, the synclines being often marked by ridges and the anticlines by valleys.

A marked feature of the northern field is the buried valley of the Susquehanna, extending from Pittston to Nanticoke. This is the bed of a former glacial stream which has cut down into the coal measures in places, thus cutting out large areas of the upper coal beds. The valley is now filled with sand, and there are numerous pot holes in it, which add an element of uncertainty and danger to the mining.

The Wyoming-Lackawanna basin is deepest (2,200 feet) midway between Wilkes-Barre and Nanticoke. About 4 miles above Pittston, near Lackawanna station, only 100 to 150 feet of the coal measures are left, but northeast from here, several miles above Scranton, the coal measures sink again to a depth of 700 feet, and then rise and spoon out beyond Forest City.

It is difficult to state the number of workable beds, as beds are now being worked in the upper end of the Lackawanna Valley which a very few years ago were neglected and considered unworkable. The splitting of a large coal bed into several smaller beds, which divide and are sometimes separated by as much as 200 feet of rock, renders it impossible to correlate beds in different parts of the field until continuous sections can be made by means of actual mine workings. As the result of measurements of 891 sections by the second geological survey of Pennsylvania, 81.8 per cent of the total coal in the Wyoming basin is or may be considered marketable coal, the remaining 18.2 per cent being interbedded slate, shale, and other refuse. The deposits in this section are particularly free from refuse, and the comparative freedom of this section from plication and folding gives a high percentage of marketable coal.

**EASTERN-MIDDLE FIELD.**

The structure of the eastern-middle field is simple, consisting of a succession of anticlines, usually with broad flat crests and shallow intervening basins only about

<sup>a</sup> H. H. Stoek, The Pennsylvania anthracite coal fields: 22d annual rept., 1900-1901, U. S. Geol. Survey, 1901, p. 69.



500 to 600 feet deep, the sides dipping  $10^{\circ}$  to  $40^{\circ}$ . This gives a large extent of outcrop, and the comparative shallowness of the basins has been very favorable to mining, so that the field has been extensively developed and its structure quite thoroughly determined. The Mammoth, Buck Mountain, Primrose, Parlor, Portland, and Gamma beds vary in thickness in different localities. The second geological survey of Pennsylvania estimated that from 75 to 77 per cent of the total thickness of coal was marketable.

#### SOUTHERN FIELD.

The southern field consists of a number of connected basins which grow gradually deeper from north to south, culminating along the foot of Sharp Mountain in very deep, highly upturned, and greatly contorted measures. The Pottsville conglomerate in this region is very thick, ranging from 1,100 to 1,475 feet. It is made up of coarse materials, and contains a number of valuable coal beds, especially at the western end. At the point where the main field subdivides into the two westwardly extending basins there are 6 Lykens Valley beds in the conglomerate, each 3 to 10 feet thick. The coal measures proper are at least 2,500 feet thick, and 20 different coal beds have been worked. From measurements of 275 sections the second geological survey estimated 72 per cent of the coal as marketable.

#### WESTERN-MIDDLE FIELD.

In the western-middle field the beds incline steeply, the average dip being 35 to 40 degrees. There has been much folding, sliding, and shifting of strata, which has crushed the coal in many places and mixed with it slate and bony coal partings. The coal measures are 1,200 feet thick, and contain from 10 to 12 different beds, many of them of great thickness and with comparatively small intervening barren intervals. The Lykens Valley beds are also found in the conglomerate, or No. 12, and toward the western end of the field these beds are mined; 1,144 sections throughout the field give 23 per cent of refuse in the coal, but it is not safe to estimate more than 75 per cent of the original deposit as marketable coal.

Fire damp is found in many of the deeper mines, particularly in the Wyoming region and in the western end of the Schuylkill region. In a number of mines it is present in such quantities that the use of safety lamps is absolutely necessary.

#### MINING METHODS.

In each of the anthracite fields there are a number of places where the coal outcrops near the surface, and where conditions are favorable for mining the coal by open-pit methods. The overburden is stripped by hand labor, steam shovel, or wire-rope tramway and the coal quarried out and hauled by incline to the surface, or if the stripping pit communicates with the underground workings the coal may be taken through underground haulage ways to the bottom of the shaft or slope and then hoisted to the surface.

Most of the mines are shaft and slope mines, the slopes being driven in the coal from the outcrop, and the shafts being always vertical and usually so placed as to cut the coal at the lowest possible elevation on the property in question. The room-and-pillar system is the one usually used for underground mining, but owing to the deposits being



steeply inclined and more or less irregular, the system has to be adapted to meet local conditions in mining the various beds. It is impossible to carry out a typical room-and-pillar system, as in the flat bituminous coal beds. The details of the system under different mining conditions vary so widely that a comparison of mining methods from different districts or localities gives the impression that the coal is mined by several systems having nothing in common. On close inspection, however, the fact is disclosed that they all have three features which are identical:<sup>a</sup> (1) The breasts, or rooms, or working places are all long and comparatively narrow; (2) they are driven nearly parallel to each other; and (3) they are separated by long narrow pillars of coal, broken only by small openings for ventilation.

These three features, which are common to all anthracite workings in Pennsylvania, are the identifying characteristics of the "pillar-and-breast," "pillar-and-room," "post-and-stall," "stoop-and-room," or "bord-and-pillar" system. The geologic peculiarities of the anthracite coal beds explain why the mining methods differ so radically in detail from those employed in other beds. Coal beds ranging from 3 or 4 feet up to 70 feet in thickness are worked on dips varying from horizontal to vertical.

From the bottom of the shaft or slope a gangway and a parallel airway are driven in opposite directions from the shaft or slope and along the strike of the bed. From these gangways rooms or breasts are turned either at right angles or obliquely, the angle of turning being dependent upon the dip of the seam.

"Flat workings" is a term applied to those coal beds which vary from horizontal to a dip of about 25°. When the coal bed is flat, it is usually opened by a shaft sunk through the overlying measures. Gangways are driven from the bottom of the shaft, and when they have reached a sufficient distance to permit a thick pillar of coal being left to protect the shaft, breasts are opened from the upper side of each gangway.

Where the inclination is more than 30°, the coal will slide without the use of sheet-iron chutes, and it then becomes necessary to stop up the lower end by a battery, built of logs or heavy planks. This acts as a support for the broken coal and allows the breast to fill to the face with coal, thus giving the miners a broken-coal platform on which to stand while working.

The battery workings may be divided into two general classes: (1) Where the coal is stored in the breast and the rock and refuse taken out through a chute, and (2) where the rock is stored in a breast and the coal taken out through chutes. Details of the various modifications of these systems are given fully by Chance.<sup>b</sup>

<sup>a</sup> Chance, H. M., *Mining methods and appliances used in the anthracite coal fields*: Second Geol. Survey of Pennsylvania, 1883, p. 129.

<sup>b</sup> Chance, H. M., *loc. cit.*

In the anthracite mines rotary drills are used and the coal is broken by the use of black powder. Dynamite or giant powder is used largely for rock work and sometimes for driving gangways in coal. Dynamite shatters the coal so badly that it is not used extensively for the mining of coal. The coal is not undercut as a general rule, and it is only recently that special mining machines have been developed for the anthracite field.

Table 50 shows the amount of explosives used in the anthracite fields from 1899 to 1913. It will be noted that the increase in the amount of dynamite used has been about fivefold since 1899, whereas the amount of black powder used has increased only about one-third. In 1909 permissible explosives were introduced into the anthracite mines and in five years the quantity used has increased from 666,807 pounds to 3,323,645 pounds in 1913. The fatalities due to the use of explosives in the anthracite mines are given in Table 49.

Every known form of haulage is to be found in the anthracite mines; the main ones are indicated in Table 54. The number of horses and mules used in the mines has remained practically the same since 1898, averaging about 15,000 per year. The number of steam locomotives used has almost doubled, whereas the number of electric locomotives has increased from 24 in 1898 to 781 in 1913. The number of compressed-air locomotives has increased from 10 in 1898 to 161 in 1913. Cars are usually gathered from the rooms by mules except where the grade is sufficient to run the cars out by gravity. The cars vary in size from 70 to 140 cubic feet and in capacity from  $1\frac{3}{4}$  to 4 tons. They are usually built of wood with iron bands, although steel cars have been introduced in recent years.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The official inspection of coal mines in Pennsylvania was established by an act approved April 12, 1869, applicable only to anthracite mines in Schuylkill County. The appointment of the inspector was vested in the governor, and the inspector was required to investigate the cause of every accident resulting in death or serious injury. Mine operators were required to report to the inspector within 24 hours all accidents resulting in death or personal injury. The inspector rendered annual reports to the governor and enumerated therein all accidents in and about the mines.

An act approved March 3, 1870, terminated the services of the inspector appointed under the act of April 12, 1869, and authorized the governor to appoint, upon the recommendation of the examining boards, six mine inspectors—three for the counties of Luzerne (including what is now Lackawanna County) and Carbon and three for the counties of Schuylkill, Dauphin, Northumberland, and Columbia.

Annual reports, in which all accidents were enumerated, were rendered to the governor. An act approved April 5, 1870, divided the inspection counties into two districts and authorized the appointment for each district of a clerk, to whom the inspectors were required to render monthly reports of deaths and injuries.

On May 9, 1871, an act was approved requiring coal companies in counties where there was no inspector to furnish a report of all accidents to the auditor general, who was required to publish an annual report and state therein the causes of such accidents. The auditor's report was published under the title of "Mineral Statistics of Pennsylvania." The act of April 25, 1873, transferred the authority to appoint the mine inspectors from the governor to a majority of the board of examiners provided for by the act of March 3, 1870, but the appointive power was again vested in the governor by an act approved May 18, 1878. On June 30, 1885, an act was approved applicable to all anthracite mines employing more than 10 men. The anthracite counties were divided into seven districts and the inspectors were required to render annual reports to the secretary of internal affairs. The number of inspection districts was increased to eight by an act approved June 2, 1891. An act of July 15, 1897, made it unlawful to employ as a miner any person not holding a certificate of competency from the miners' examining board established by the act. An act of July 15, 1897, established a bureau of mines in the department of internal affairs.

An act approved June 8, 1901, effective January 1, 1902, changed the manner of selecting the mine inspectors by making the office elective instead of appointive. The number of elective districts was reduced to 6, but the number of inspectors was increased to 15. It was provided that the inspectors should be elected from among a list of eligibles certified to the secretary of state by the examining board. The inspectors so elected rendered monthly reports to the chief of the Bureau of Mines and also rendered annual reports to the secretary of internal affairs.

An act of April 14, 1903, established the department of mines.

On May 3, 1905, an act was approved increasing the number of districts to 7, and the number of inspectors to 20, and requiring the inspectors to make annual reports to the chief of the department of mines. An act of May 5, 1911, provided for 8 elective districts and 21 inspectors, and an act of June 1, 1915, increased the number of anthracite inspectors to 25.

Under the inspection laws, it is the practice of the operators to report to the district inspectors all injuries causing disability for 6 days or more. The district inspectors, in their reports to the department of mines, omit accidents of a less serious nature, so that only the more serious injuries are published in the annual report of the



department of mines. The department has not officially defined a serious injury, and it is left to the discretion of each district inspector as to which of the accidents reported to him by mine operators may be eliminated from his report to the department.

#### ACCIDENTS.

Tables 124 and 125 show the total number of men employed and the number of men killed from the beginning of inspection service in 1870 to date. During the period 1870 to 1913, inclusive, 17,716 fatalities occurred in and about the anthracite mines, representing a rate of 3.42 per 1,000 men employed. The amount of coal mined per fatality was 124,968 tons, or there were 8 fatalities per million tons mined.

Table 125 shows the number of fatalities by causes, in conformity with the latest reports of the State mine inspector and so adapted as to conform with the standard form used by the Bureau of Mines. This classification gives much more detail than is ordinarily available, and it is believed will be of material assistance to operators, inspectors, and others, who are making a study of mine accidents, their causes, and their prevention.

Of the total number of fatalities that have occurred during this period, 41.65 per cent was due to falls of roof and coal; 13.56 per cent to mine cars and locomotives; 10.10 per cent to explosives; and 7.59 per cent to explosions of gas. The percentage of fatalities due to explosives in the anthracite mines is practically 5 times that in the Pennsylvania bituminous fields, given in tables relating thereto, whereas the rate per 1,000 men employed is 7 times as high as it is in the bituminous fields of the State.

Since 1869 to the end of 1914 there have been in the anthracite field 80 accidents in each of which 5 or more men have been killed at one time. A complete list of these disasters is shown in the accompanying table.

FATALITIES IN **PENNSYLVANIA ANTHRACITE** COAL MINES, BY PRINCIPAL CAUSES DURING THE YEARS 1870 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	7,378	41.65	1.42
Mine cars and locomotives.....	2,403	13.56	.46
Gas explosions.....	1,344	7.59	.26
Explosives.....	1,790	10.10	.35
Miscellaneous.....	1,637	9.24	.32
Shaft.....	843	4.76	.16
Surface.....	2,321	13.10	.45
Total, 44 years.....	17,716	100.00	3.42



ACCIDENTS IN PENNSYLVANIA ANTHRACITE MINES IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1847 Feb. —	Spencer.	Pottsville.	Mine explosion.	7
1869 Sept. 6.	Avondale.	Plymouth.	Mine fire.	179
1870 Mar. 22.	Potts.	Potts mine.	Explosion of breaker boilers.	5
1870 Aug. 10.	Heins & Glassmire.	Middleport.	Cage fell down shaft.	9
1870 Aug. 29.	Preston No. 3.	Girardville.	Fell down slope.	7
1871 May 27.	West Pittston.	West Pittston.	Smoke from burning breaker.	20
1871 Oct. 2.	Otto Red Ash.	Branch Dale.	Mine explosion.	5
1873 June 10.	Henry Clay.	Shamokin.	do.	10
1877 May 9.	Wadesville.	Wadesville.	do.	7
1878 Jan. 15.	Potts.	Locust Dale.	do.	5
1879 May 6.	Audenried.	Audenried.	Mine fire.	6
1880 May 3.	Lykens Valley.	Shamokin.	Mine explosion.	5
1882 May 24.	Kohinoor.	Shenandoah.	do.	5
1884 Aug. 21.	Buck Ridge.	Shamokin.	Mine fire.	7
1885 Apr. 6.	Cuyler.	Raven Run.	Fall of roof.	10
1885 Aug. 11.	West End.	Mocanagua.	Gas from boiler fires in mine.	10
1885 Oct. 21.	Plymouth No. 2.	Plymouth.	Mine explosion.	6
1885 Dec. 18.	Nanticoke No. 1.	Nanticoke.	Buried by inrush of quicksand.	26
1886 Aug. 30.	Fair Lawn.	Scranton.	Mine explosion.	6
1886 Sept. 13.	Marvine.	do.	Suffocated by inrush of mine gas.	8
1886 Nov. 26.	Conyngham.	Wilkes-Barre.	Mine explosion.	12
1887 Apr. 27.	Tunnel.	Ashland.	Suffocated by inrush of mine gas.	5
1889 May 9.	Kaska William.	Middleport.	Mine car fell on men in cage.	10
1890 Feb. 1.	Nottingham.	Plymouth.	Mine explosion.	8
1890 Mar. 3.	Shaft No. 3.	South Wilkes-Barre.	do.	8
1890 Apr. 2.	Susquehanna No. 4.	Nanticoke.	do.	5
1890 May 15.	Jersey No. 8.	Ashley.	do.	26
1891 Feb. 4.	Spring Mountain No. 1.	Jeanesville.	Drowned by inrush of water from abandoned workings and asphyxiated by gas from fire built by imprisoned men.	13
1891 Oct. 23.	Richardson.	Glencarbon.	Imprisoned by rush of coal and suffocated by mine gas.	7
1891 Nov. 8.	Susquehanna No. 1.	Nanticoke.	Mine explosion.	12
1892 Apr. 20.	Lytle.	Minersville.	Drowned by water from old workings.	10
1892 July 23.	York Farm.	Pottsville.	Mine explosion.	15
1893 Apr. 1.	Neilson.	Shamokin.	Mine fire.	10
1893 June 22.	Susquehanna No. 1.	Nanticoke.	Mine explosion.	5
1893 Sept. 21.	Lance No. 11.	Plymouth.	do.	6
1894 Feb. 13.	Caylord.	do.	Fall of roof.	13
1894 July 17.	East Sugar Loaf.	Stockton.	Dynamite explosion.	8
1894 Oct. 8.	Luke Fidler.	Shamokin.	Mine fire.	5
1894 Oct. 11.	Henry Clay.	do.	Boiler explosion.	5
1895 Feb. 18.	West Bear Ridge.	Mahanoy Plane.	Mine explosion.	5
1895 Oct. 7.	Dorrance.	Wilkes-Barre.	do.	7
1896 June 28.	Twin.	Pittston.	Fall of roof.	58
1896 Oct. 29.	Shaft No. 3.	South Wilkes-Barre.	Mine explosion.	6
1897 Jan. 13.	Wadesville.	Wadesville.	Crosshead fell down shaft.	5
1897 Sept. 28.	Jermyn No. 1.	Rendham.	Mine fire.	5
1897 Oct. 30.	Von Storch.	Scranton.	do.	6
1898 May 26.	Kaska William.	Middleport.	Drowned by water from old workings.	6
1898 Oct. 1.	Midvale.	Wilkes-Barre.	Mine fire.	5
1898 Nov. 5.	Exeter.	West Pittston.	Mine car fell on men in cage.	9
1900 Nov. 9.	Buck Mountain.	Mahanoy.	Mine explosion.	7
1901 Oct. 25.	Buttonwood.	Plymouth.	do.	6
1902 Nov. 29.	Luke Fidler.	Shamokin.	do.	7
1902 Dec. 9.	South Wilkes-Barre.	South Wilkes-Barre.	Dynamite explosion.	5
1904 Jan. 30.	Maple Hill.	Mahanoy City.	do.	5
1904 May 5.	Lance.	Plymouth.	do.	5
1904 May 5.	Locust Gap.	Locust Gap.	Mine fire.	5
1904 May 25.	Williamstown.	Williamstown.	Suffocated by gases from locomotive.	10
1904 Nov. 2.	Auchincloss.	Nanticoke.	Fell down shaft.	10
1905 Feb. 18.	Lytle.	Minersville.	Fall of roof.	5
1905 Mar. 9.	Clear Spring.	West Pittston.	Fell down shaft.	7
1905 Apr. 26.	Conyngham.	Wilkes-Barre.	do.	10
1906 May 15.	Shenandoah City.	Shenandoah.	Dynamite explosion.	7

## 288 COAL-MINE FATALITIES IN THE UNITED STATES, 1870-1914.

## ACCIDENTS IN PENNSYLVANIA ANTHRACITE MINES IN WHICH 5 OR MORE MEN WERE KILLED—Continued.

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1906 Aug. 6.....	Susquehanna No. 7.....	Nanticoke.....	Mine explosion.....	6
1907 Mar. 2.....	Holden.....	Taylor.....	.....do.....	7
1907 June 18.....	Johnson No. 1.....	Priceburg.....	.....do.....	7
1908 May 12.....	Mount Lookout.....	W. coming.....	.....do.....	12
1908 May 13.....	Prospect.....	Wilkes-Barre.....	Fall of roof.....	5
1908 July 15.....	Williamstown.....	Williamstown.....	Powder explosion.....	6
1908 Aug. 28.....	Warrior Run.....	Wilkes-Barre.....	Mine cars.....	6
1909 Mar. 2.....	No. 11.....	Pittston.....	Mine explosion.....	8
1909 Nov. 9.....	Auchincloss.....	Nanticoke.....	Mine fire.....	9
1910 Jan. 11.....	Nottingham.....	Plymouth.....	Mine explosion.....	7
1910 Mar. 12.....	South Wilkes-Barre No. 5.....	Wilkes-Barre.....	.....do.....	7
1911 Apr. 7.....	Price-Pancoast.....	Throop.....	Mine fire.....	72
1911 May 27.....	Cameron.....	Shamokin.....	Mine explosion.....	5
1911 Sept. 12.....	Marvin.....	Scranton.....	Mine cars.....	5
1911 Oct. 3.....	Drift No. 2.....	Freeland.....	Cave-in.....	5
1912 Jan. 9.....	Parrish.....	Plymouth.....	Mine explosion.....	6
1913 Aug. 2.....	East Brookside.....	Tower City.....	.....do.....	19
1914 May 29.....	Maryd.....	Maryd.....	Overwinding of cage.....	6
1914 Sept. 16.....	Lehigh No. 4.....	Lansford.....	Mine explosion.....	7
1914 Dec. 9.....	Tripp.....	Scranton.....	Collapse of bottom of cage.....	13
1915 Feb. 17.....	Prospect.....	Wilkes-Barre.....	Mine explosion.....	13

Since 1903, the Pennsylvania anthracite mines have been operated on a 9-hour working day, and, for comparison with other States in which the mines are operated 8 or 10 hours, Table 40 has been compiled. The table shows that the number of hours worked per year per man in the anthracite field is 1,985, as compared with 2,034 for the bituminous field. The fatality rate in the anthracite field based on the actual number of employees is 3.73, during the 10-year period 1903 to 1913, except 1909, whereas based on the number of 2,000-hour workers it is 3.76. The difference in this instance is slight, but for Ohio, where the hours worked per year are 1,495, the fatality rate

## NUMBER OF HOURS WORKED IN AND ABOUT THE PENNSYLVANIA ANTHRACITE MINES AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day. <sup>a</sup> (all employees.)	Total hours per year.	Number of 2,000 hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	206	1,354,347	278,995,482	139,498	518	3.71
1904.....	200	1,402,749	280,549,800	140,275	595	4.24
1905.....	215	1,488,654	320,060,610	160,031	644	4.02
1906.....	195	1,461,195	284,933,025	142,467	557	3.91
1907.....	220	1,505,106	331,123,320	165,562	708	4.28
1908.....	200	1,567,566	313,513,200	156,757	678	4.33
1909 <sup>b</sup> .....						
1910.....	229	1,525,473	349,333,317	174,667	601	3.44
1911.....	246	1,565,460	385,103,160	192,551	699	3.63
1912.....	231	1,566,270	361,808,370	180,904	601	3.32
1913.....	257	1,581,705	406,498,185	203,249	618	3.04

<sup>a</sup> Calculated on the 9-hour basis.

<sup>b</sup> Census year.

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE PENNSYLVANIA ANTHRACITE MINES.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....				1907.....			
1900.....	<i>b</i> 100,000	<i>b</i> 3,500,000	<i>b</i> 35	1908.....			
1901.....				1909.....			10
1902.....	<i>b</i> 115,000	<i>b</i> 4,210,000	<i>b</i> 98	1910.....	771	8,016	6
1903.....				1911.....	2,853	15,739	6
1904.....	2,228	34,103	15	1912.....	5,900	36,958	45
1905.....	4,998	33,986	7	1913.....	151,958	6,913,475	8
1906.....	161,039	5,958,443	37	1914.....	64,086	481,678	7
					26,115	179,743	

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.<sup>b</sup> Approximate.

based on the actual number of men employed is 2.94, and on the number of 2,000-hour workers is 3.94. The fatality rate in Ohio on this basis more nearly equals the rate in the anthracite field than when based on the actual number of employees. From these tables, comparisons with other States may be readily made. The tables of statistics for the anthracite mines of Pennsylvania follow:

TABLE 124.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN PENNSYLVANIA (ANTHRACITE), BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE. *a*

[Figures for total production and all items below horizontal lines selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 and all items above horizontal lines in columns 3 and 8 from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10 prior to 1901, calculated.]

Year.	Production (short tons).			Value per ton at mine.	Number employed.	Number killed.				Production per death (short tons).		Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						
	1	2	3			4	Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.	7	8		9	10	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.	21
1807-1869.	232,765,704			186																					
	15,664,275		35,600	211		5.93	13.47	74,238		440															
	19,342,057		37,488	210		5.60	10.86	92,105		516															
	24,233,166		44,745	223		5.46	9.20	108,669		543															
	26,152,837		48,199	263		5.46	10.06	99,440		543															
	24,818,790		53,402	231		4.33	9.31	107,441		465															
	22,485,766		69,966	236		3.37	10.50	95,279		321															
	22,793,245		70,474	227		3.22	9.96	100,411		323															
	25,660,316		66,842	194		2.90	7.56	132,270		384															
	21,689,682		63,964	187		2.92	8.62	115,988		339															
	30,207,793		68,847	262		3.81	8.67	115,997		439															
	28,649,812		73,373	262		7.05	7.05	141,831		390															
	31,920,018		76,031	273		8.59	8.55	116,923		420															
	35,121,256		82,900	293		8.54	8.29	120,692		427															
	38,456,845		91,421	323		3.38	8.40	119,081		362															
	37,156,847		101,073	332		3.28	8.94	111,918		368															
	38,335,974	\$2.00	100,324	359		3.58	9.36	106,785		382															
	39,035,446	1.95	103,044	278		2.78	7.12	140,415		379															
	42,088,197	2.01	106,517	314		2.95	7.46	134,039		385															
	46,619,564	1.91	122,218	364		2.98	7.81	128,076		381															
	45,546,970	1.44	123,676	355		3.11	8.45	118,304		368															
	46,468,641	1.43	126,000	378		3.00	8.13	122,933		369															
	50,665,431	1.46	126,350	428		3.40	8.45	118,377		203															
	52,472,504	1.57	129,050	418		3.24	7.97	125,532		198															
	53,967,543	1.59	132,944	455		3.42	8.43	118,610		197															
	53,983,893	1.58	134,631	445		3.38	8.57	116,677		190															
	51,921,121	1.85	131,603	445		3.83	8.57	116,677		190															
	57,999,337	1.41	142,917	42		2.95	7.26	137,766		196															



1896.	54,346,081	1.50	148,991	501	3.36	9.22	108,475	174	365	2.10									
1897.	52,611,680	1.51	149,884	423	2.82	8.04	124,377	150	351	2.34									
1898.	53,382,644	1.41	145,504	411	2.82	7.70	129,885	152	367	2.41									
1899.	60,418,065	1.46	139,608	461	3.30	7.63	131,059	173	433	2.50									
1900.	57,367,915	1.49	144,268	411	2.85	7.16	139,581	166	398	2.40									
1901.	67,471,667	1.67	145,399	513	3.53	7.60	131,524	196	464	2.37									
1902.	41,373,595	1.84	148,141	300	2.03	7.25	137,912	116	279	2.41									
1903.	74,607,068	2.04	150,483	518	3.44	6.94	144,039	206	406	2.41									
1904.	73,156,769	1.90	155,891	595	3.82	8.13	122,932	200	469	2.35									
1905.	77,659,830	1.83	165,406	644	3.89	8.29	120,590	215	470	2.19									
1906.	71,282,411	1.85	162,355	557	3.43	7.81	127,976	195	439	2.25									
1907.	85,604,312	1.91	167,234	708	4.23	8.27	120,910	220	512	2.33									
1908.	83,268,754	1.90	174,174	678	3.89	8.14	122,815	200	478	2.39									
1909.	81,070,359	1.81	166,801	567	3.40	6.99	142,981	(b)	486										
1910.	84,485,236	1.90	169,497	601	3.55	7.11	140,574	229	498	2.17									
1911.	90,464,067	1.94	173,940	699	4.02	7.73	129,419	246	520	2.11									
1912.	84,361,398	2.11	174,030	601	3.45	7.12	140,369	231	485	2.10									
1913.	91,324,922	2.06	175,745	618	3.52	6.75	148,099	257	521	2.03									
Total	2,446,696,010			17,902															
Average (1870-1913).	50,316,598		117,851	402.64	3.42	8.00	124,968	200	427	2.14									
1914.	90,821,507	2.07	179,679	595	3.31	6.55	152,641	245	505	2.06									271

a Figures in italics represent incomplete fatality records.

b Not reported.

TABLE 125.—NUMBER OF MEN KILLED IN AND ABOUT THE ANTHRACITE MINES IN PENNSYLVANIA, WITH FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1870 TO 1914, INCLUSIVE.

Year.	Underground.															Shaft.		Surface.										Grand total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	Falls of roof (coal, rock, etc.).					Falls of face or pillar coal.					Mine cars and locomotives.					Gas explo- sions and burning gas.					Other causes.					Total shaft.	Total surface.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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1870.	10	8	8	1	1	45	11	3	1	15	6	1	10	31	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1





**PENNSYLVANIA (BITUMINOUS).****AREA AND DISTRIBUTION OF COAL FIELDS.**

The bituminous coal fields of Pennsylvania are in the western and southwestern part of the State, and comprise the northern end of the great Appalachian series of coal measures. The fields include about 14,200 square miles, covering 12 counties and parts of 21 other counties. The structure conforms to the system of Appalachian folding in long northeast-southwest waves, locally modified more or less by minor cross folds. In the northwestern part of the area the strata gently undulate, with extremely slight dips, generally of but a few feet to the mile, but in passing eastward these undulations increase to well-marked folds along the eastern margin of the main body of the coal field.

**CHARACTER OF COAL BEDS.**

The bituminous coal fields of Pennsylvania are described by Parker<sup>a</sup> as follows:

The coal-bearing rocks all belong to the Pennsylvania series and have a total thickness in the southwest corner of the State of about 2,600 feet. The great bulk of the coal mined comes from the Allegheny and the Monongahela formations, formerly known as the "Lower" and the "Upper Productive Coal Measures." Below the Allegheny formation is the Pottsville, containing, in the western part of the State, the Sharon and the Mercer coals, which have been worked only in restricted areas. The Allegheny formation, with a thickness of 250 to 350 feet, contains at least seven coal horizons, all of which yield workable coal locally. They are called, beginning at the bottom, the Brookville, Clarion, Lower Kittanning, Middle Kittanning, Upper Kittanning, Lower Freeport, and Upper Freeport coals. It is now definitely recognized that the coals of these horizons do not occur in continuous beds, and in many cases not in exactly the same horizons; yet it is clear that the corresponding geologic horizons mark times of conditions generally favorable for coal formation, and that no coal of wide extent is found at other levels. As a rule, the coal beds are not characterized by details of section, roof, or floor by which they can be clearly recognized, except over limited parts of the field. No one of them is continuously workable, but the Lower Kittanning and the Upper Freeport coals are widely workable, and the Lower Freeport has a splendid development over several counties in the northeast part of the field. The Brookville or A coal is of workable thickness in spots over a large part of the marginal belt of the coal measures, especially in Jefferson, Clearfield, Center, Cambria, and Somerset counties. The Clarion or A' coal reaches workable thickness in about the same belt, though the two are seldom of workable thickness in the same section. Both of these coals are apt to be impure when thick. The lower Kittanning or B coal is the most persistent, uniform, and reliable of the Allegheny coals, although it is thinner than the Freeport coals, seldom exceeding a thickness of 4 feet. It is exposed in workable thickness and purity in 11 of the counties. The Middle and the Upper Kittanning horizons, C and C', contain but little workable coal, though the Upper Kittanning shows cannel coal at a number of points and stands fourth in productivity. The Lower Freeport coal, D, is finely developed in Clearfield, Jefferson, Indiana, and Cambria counties—in the well-known Moshannon (Clearfield), Reynoldsville-Punxsutawney, and Barnesboro-Patton basins. Over most of the rest of the territory this seam is either worthless or of too low grade for competition in the present market. The Upper Freeport or E coal is a variable and complex bed, extending in gross workable thickness over most of its area, although over a considerable

<sup>a</sup> Parker, E. W., *Coal: Mineral Resources of the United States for 1910*, U. S. Geol. Survey, pt. 2 p. 195.



part of this territory it is too much broken up and too impure for profitable mining. It appears to be entirely absent in some localities.

As a whole, the Allegheny formation yields about 40 per cent of the total output of bituminous coal in the State.

For about 600 feet above the Upper Freeport bed occurs the Conemaugh formation or "Lower Barren Measures." It contains six or more coals, which, however, are workable only in very restricted areas, their best development being found in the Berlin Basin in Somerset County.

Just above the Conemaugh formation lies the Pittsburgh coal, the most uniform in quality and thickness, and for a given area the most valuable coal bed in the bituminous field of Pennsylvania. Although not of as high a grade as the best Allegheny coals to the east, and although varying greatly in quality from east to west, on the whole the Pittsburgh coal, on account of its thickness, its regularity, its high grade, its adaptability for the production of coke and illuminating gas, has long been the most famous bituminous coal bed in America. It is confined to the southwestern part of the State. The bed gives 9 feet of available coal over large areas, and seldom runs under 4 feet. Above the Pittsburgh coal occur the Redstone, Sewickley, Uniontown, and Waynesburg coals, which are of good workable thickness locally, but in the presence of the great Pittsburgh coal are but little mined.

#### METHODS OF MINING.

The earliest records of the United States Geological Survey show that bituminous coal has been mined in Pennsylvania since 1840. Most of the bituminous coal mines of Pennsylvania are opened by drift from the outcrop, or by a gentle slope down the dip of the bed. There are but few relatively deep mines as compared with the deep coal mines of Europe, the anthracite fields of Pennsylvania, or the metal mines. In the earlier years of the industry many of the mines were opened by single entry, but in recent years the larger operations and newer mines are opened by double or triple entry. The room-and-pillar system is used throughout the bituminous fields of Pennsylvania.

In 1896 about 12 per cent of the coal was reported as being mined by machines. The amount of coal produced by machines has steadily increased until in 1914 it was 53.8 per cent. Shooting off the solid is not extensively practiced, the total amount of coal thus produced being less than 3 per cent. About 35 per cent of the coal is reported as being mined by hand. In 1914, there were 6,326 machines in operation.

Table 54 shows the increase in mechanical haulage in the bituminous mines from 1899 to the close of 1913. In 1899 there were 122 electric locomotives in operation and in 1913, 1,933. The number of compressed-air locomotives has also increased from 13 in 1899 to 168 in 1913. The number of mules and horses used in underground haulage has practically doubled since 1898. The amount of black powder (Table 50) used in the bituminous coal mines has a little more than doubled since 1899, whereas the use of dynamite increased gradually from 1899 to 1907. Since 1907 the amount of dynamite used has decreased rapidly, and has largely been replaced by the use of permissible explosives.

**REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The first law providing for the inspection of bituminous mines in Pennsylvania, approved April 18, 1877, applied to all mines employing more than 10 men, except mines which did not generate fire damp, black damp, or other dangerous or noxious gases. A board of examiners was provided for the purpose of examining applicants for appointment as mine inspector. From a list of eligibles thus established the governor was authorized to appoint three inspectors, one for each of three districts into which the bituminous coal fields were to be divided by the examining board. Each inspector was required to examine all mines in his district as often as possible, to make a record of such examinations, showing the number of employees, number of deaths and injuries in and about the mines, and to file a record thereof each month in the office of the secretary of internal affairs, to be included by the secretary in the annual report of his department. Operators were required to notify the district inspector of all fatal and serious accidents, and on receiving such notice the inspector was required to visit the mine and investigate the cause of the accident.

An act approved May 25, 1878, repealed the provision in the law of April 18, 1877, which exempted from the inspection law those mines which did not generate fire damp, black damp, or other noxious or dangerous gases. The law of June 3, 1881, increased the number of inspection districts to four, and the number was further increased to six by an act approved June 13, 1883. The latter law also required the inspectors to make annual reports to the secretary of internal affairs.

On June 30, 1885, the examining board was authorized to divide the bituminous coal fields into eight districts, the governor to appoint a mine inspector for each district. An act approved May 15, 1893, authorized the examining board to further divide the bituminous fields into districts of not less than 60 mines nor more than 80 mines, and the governor was authorized to appoint an inspector for each district established by the board.

The number of inspectors was increased in 1894 to 10, in 1901 to 12, in 1903 to 15, in 1905 to 16, in 1906 to 18, in 1907 to 20, in 1909 to 21, in 1911 to 25, in 1912 to 26, in 1913 to 28, and in 1915 to 30.

Mine foremen were required to make monthly reports to the district inspector showing all accidents resulting in personal injury to mine employees. On June 9, 1911, an act was approved by which the State was divided into 25 bituminous districts and the chief of the department of mines was authorized to increase the number of districts with the approval of the governor. The district inspectors were directed to render both monthly and annual reports to the chief of the department of mines, and to enumerate all accidents in and about the mines.

Under the inspection laws it is the practice of the operators to report to the district inspectors all injuries causing disability for 6 days or more. The district inspectors, in their reports to the department of mines, omit accidents of a less serious nature, so that only the more serious injuries are published in the annual report of the department of mines. The department has not officially defined a serious injury, and it is left to the discretion of the district inspectors as to which of the accidents reported to them by mine operators may be eliminated from their reports to the department.

#### ACCIDENTS.

Tables 126 and 127 show the production of coal, number of men employed, and the number of fatalities in and about the bituminous coal mines of Pennsylvania. The record of the number of men employed and the fatalities is complete from the beginning of inspection service in 1877 to the end of 1913. The fatalities, as shown in the accompanying tables, have been compiled from the annual volumes of the State mine inspectors' reports. In a few instances slight changes have been introduced, owing to the fact that some of the earlier inspectors' reports included accidents at coke ovens, and others included deaths due to natural causes. In all cases where sufficient information was given, all fatalities that occurred which were foreign to the mining operations have been excluded from the tables.

During the 37-year period 1877 to 1913, inclusive, there were 9,473 fatalities attributed directly to the coal-mining industry. This represents a fatality rate of 2.87 per 1,000 men employed. The amount of coal mined per fatality, during the entire period, was 271,832 tons, or there were 3.68 fatalities per million tons mined. Since 1879, there have been 37 mine disasters in each of which 5 or more men were killed at one time, the total fatalities thus represented being 1,268, or about 13 per cent of the entire number since 1877. Of the total number of fatalities, 56.93 per cent was due to falls of roof; 15.33 per cent to mine cars and locomotives; and 13.82 per cent to gas and dust explosions. The fatality rate due to explosives is exceedingly low, being only 1.95 per cent of the total, as compared with 24.81 per cent in Kansas, 19.44 per cent in Indiana, 13.47 per cent in Illinois, and 3.27 per cent in West Virginia.

FATALITIES IN PENNSYLVANIA BITUMINOUS COAL MINES, BY PRINCIPAL CAUSES DURING THE YEARS 1877 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	5,393	56.93	1.64
Mine cars and locomotives.....	1,452	15.33	.44
Gas and dust explosions.....	1,309	13.82	.40
Explosives.....	185	1.95	.05
Miscellaneous.....	512	5.40	.16
Shaft.....	217	2.29	.06
Surface.....	405	4.28	.12
Total, 36 years.....	9,473	100.00	2.87



## ACCIDENTS IN PENNSYLVANIA BITUMINOUS MINES IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1879 Nov. 2.	Mill Creek.	Mill Creek.	Mine explosion.	5
1884 Feb. 20.	West Leisenring.	West Leisenring.	do.	19
1884 Oct. 27.	Youngstown.	Uniontown.	do.	14
1887 Oct. 1.	Bast.	Big Mine Run.	Suffocated by inrush of mine gas.	5
1888 Nov. 3.	Kettle Creek.	Clinton County.	Powder and coal-dust explosion.	17
1890 June 16.	Hill Farm.	Dunbar.	Mine fire.	31
1891 Jan. 27.	Mammouth.	Mount Pleasant.	Mine explosion.	109
1896 Mar. 23.	Berwind.	Dubois.	do.	13
1898 Sept. 23.	Umpire.	Brownsville.	do.	8
1899 July 24.	Grindstone.	do.	do.	5
1899 Dec. 23.	Sumner.	Sumner.	do.	19
1901 June 10.	Port Royal No. 2.	Port Royal.	do.	19
1902 Mar. 6.	Catsburg.	Monongahela.	do.	5
1902 July 10.	Rolling Mill.	Johnstown.	do.	112
1903 Nov. 21.	Ferguson.	Connellsville.	do.	17
1904 Jan. 25.	Harwick.	Cheswick.	do.	179
1905 Apr. 27.	Eleanora.	Dubois.	do.	13
1905 July 6.	Fuller.	Searight.	do.	6
1905 Oct. 13.	Clyde.	Fredericktown.	Mine fire.	6
1905 Oct. 29.	Hazel Kirk No. 2.	Monongahela.	Mine explosion.	5
1905 Nov. 15.	Braznell.	Bentleyville.	do.	7
1906 Oct. 24.	Rolling Mill.	Johnstown.	do.	7
1907 Aug. 17.	Sonman.	Sonman.	Fell down shaft.	5
1907 Dec. 1.	Naomi.	Fayette City.	Mine explosion.	34
1907 Dec. 19.	Darr.	Jacobs Creek.	do.	239
1908 Nov. 28.	Rachel and Agnes.	Marianna.	do.	154
1909 Jan. 25.	Orenda No. 2.	Boswell.	do.	5
1909 Apr. 9.	Eureka No. 37.	Windber.	Dynamite and mine explosion.	7
1909 June 23.	Lackawanna No. 4.	Wehrum.	Mine explosion.	21
1909 Oct. 31.	Franklin No. 2.	Johnstown.	do.	13
1910 Feb. 5.	Ernest No. 2.	Ernest.	do.	12
1911 Mar. 22.	Hazel.	East Canonsburg.	Fall of roof.	9
1911 July 13.	Sykesville.	Sykesville.	Mine explosion.	21
1911 Nov. 9.	Adrian.	Punxsutawney.	do.	8
1912 July 24.	Superba and Lemont.	Evans Station.	Cloudburst flooded mine.	a 18
1913 Apr. 23.	Cincinnati.	Finleyville.	Mine explosion.	96
1915 May 24.	Smokeless Valley No. 1.	Johnstown.	do.	9
1915 July 30.	Patterson No. 2.	Elizabeth.	Mine cars.	9
1915 Aug. 31.	Orenda.	Boswell.	Mine explosion.	19

<sup>a</sup> Not included in State inspector's tabular statement of mine fatalities.

Table 127 showing the fatalities by causes has been amplified from the bureau's regular form by subdivisions under "Falls of roof and coal," "Gas and dust explosions," "Miscellaneous underground," and "Miscellaneous surface." This is in conformity with the State inspector's latest reports, and in no way does it conflict with the bureau's classification in comparing fatalities by causes with those of other States. The main headings have been maintained as indicated in the table by numerals; the subheadings are indicated by letters. This classification gives operators, inspectors, and others an opportunity to study the mine accidents more in detail.

Since 1903 practically one-half of the men in the bituminous coal mines of the State have been on an 8-hour basis, as shown in the accompanying table, the remainder being 9 and 10 hour men. In order to make a true comparison of Pennsylvania with other States Tables 40 and 41 have been compiled showing the fatality rate based on the actual number of men employed and also on the number of calculated 2,000-hour workers. The number of hours worked per year per man in the Pennsylvania bituminous fields is 2,034, so that



there is but slight variation in the fatality rate based on the actual number of employees during the 10-year period 1903 to 1913 (except 1909) which is 3.39 per 1,000, and that based on the number of 2,000-hour workers, which is 3.34. The number of hours worked in Virginia is 2,447, in West Virginia 2,132, and in Ohio 1,495. With such varying periods of exposure to the hazards of the mining industry, it is essential that the time factor be taken into consideration.

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE PENNSYLVANIA BITUMINOUS MINES.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	481	58,761	220	28,221	170	32,192	10,091	129,265
1904.....	637	77,960	223	24,972	187	30,286	1,882	135,100
1905.....	669	60,297	226	26,090	179	31,314	25,928	143,629
1906.....	744	92,082	233	25,695	190	30,895	3,427	152,099
1907.....	809	96,667	260	24,883	198	35,355	6,390	163,295
1908.....	764	99,406	241	24,828	197	38,125	3,602	165,961
1909 <sup>b</sup> .....								159,321
1910.....	834	101,208	272	30,270	225	37,769	6,156	175,403
1911.....	842	99,522	273	28,204	213	37,586	5,796	171,108
1912.....	774	91,928	316	32,935	214	35,322	4,959	165,144
1913.....	849	100,568	312	32,064	242	38,671	893	172,196

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE PENNSYLVANIA BITUMINOUS MINES, AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	235	1,136,816	267,151,760	133,576	395	2.96
1904.....	196	1,168,226	228,972,296	114,486	533	4.66
1905.....	231	1,263,678	291,909,618	145,955	475	3.25
1906.....	231	1,307,704	302,079,624	151,040	476	3.15
1907.....	255	1,408,343	359,127,465	179,564	799	4.45
1908.....	201	1,432,368	287,905,968	143,953	571	3.97
1909.....						
1910.....	238	1,515,188	360,614,744	180,307	521	2.89
1911.....	233	1,478,036	344,382,388	172,191	515	2.99
1912.....	252	1,429,690	360,281,880	180,141	446	2.48
1913.....	267	1,487,867	397,260,489	198,630	609	3.07

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE PENNSYLVANIA BITUMINOUS MINES.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	15,131	636,160	42	1907.....	6,447	59,834	9
1900.....	7,574	223,093	29	1908.....	18,780	375,569	20
1901.....	2,541	125,116	49	1909.....	5,824	260,381	45
1902.....	12,580	264,862	21	1910.....	60,098	2,700,746	45
1903.....	12,805	321,925	25	1911.....	5,601	148,124	26
1904.....	9,336	576,353	62	1912.....	22,538	538,248	24
1905.....	5,686	186,250	33	1913.....	17,244	274,296	16
1906.....	59,593	3,941,835	66	1914.....	36,613	1,052,005	29

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 126.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN PENNSYLVANIA (BITUMINOUS), BY CALENDAR YEARS, ALSO TO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.<sup>a</sup>

Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geological Survey. Figures in column 4 and items above horizontal lines in column 3 compiled from State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

1903.....	103,117,178	1.18	129,265	395	3.06	3.83	261,056	235	798	3.40	36.9	2,267	1,039	4	.....	3,316	
1904.....	97,988,287	.96	135,100	533	3.95	5.44	183,749	196	755	3.70	32.9	2,463	1,175	15	.....	3,645	
1905.....	118,413,697	.96	143,629	475	3.31	4.01	240,202	231	824	3.57	41.7	3,020	1,232	2	.....	4,254	
1906.....	129,203,206	1.00	152,099	476	3.13	3.08	271,624	231	850	3.68	41.6	3,103	1,363	19	.....	4,515	
1907.....	150,143,177	1.04	163,295	799	4.89	5.32	187,914	255	919	3.60	40.5	3,352	1,347	21	.....	4,940	
1908.....	117,179,527	1.01	165,961	571	3.44	4.87	205,218	201	796	3.51	41.8	3,456	1,539	8	.....	5,103	
1909.....	137,966,791	.94	159,321	500	3.14	3.62	275,934	(C)	806	(C)	41.7	3,497	1,731	38	.....	5,616	
1910.....	150,521,526	1.02	175,403	521	2.97	3.46	288,909	238	858	3.61	41.5	3,534	1,872	86	.....	6,065	
1911.....	144,561,257	1.01	171,108	515	3.01	3.56	280,701	233	845	3.63	41.3	3,596	1,871	82	.....	6,305	
1912.....	161,865,488	1.05	165,144	446	2.70	2.76	362,927	252	980	3.89	50.8	3,610	2,029	572	.....	6,176	
1913.....	173,781,217	1.11	172,195	609	3.54	3.50	285,355	267	1,099	3.78	53.4	3,391	2,086	137	.....	6,301	
Total.....	2,731,945,059	.....	.....	9,473	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Average (1877-1913).....	69,536,423	.....	89,076	256.03	2.87	3.68	271,832	229	781	3.41	37.5	3,140	1,927	96	.....	6,326	
1914.....	147,983,294	1.07	184,201	402	2.18	2.72	368,118	214	803	3.75	53.8	7.0	.....	.....	7	.....	1,482

a Figures in italics represent incomplete fatality records.

b Oct. to Dec. 31 only.

c Not reported.

TABLE 127.—NUMBER OF MEN KILLED IN AND ABOUT THE BITUMINOUS MINES IN PENNSYLVANIA, WITH FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 187 TO 1914, INCLUSIVE.

Year.	Killed underground.															Killed in shaft.		Killed on surface.										Grand total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	Falls of roof (coal, rock, pillar coal, etc.).					Falls of face or pillar coal.		Mine cars and locomotives.			Gas explosions and burning gas.				Other causes.					Other causes.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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1877 <sup>a</sup>	8	1	1	1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1





**TENNESSEE.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal fields of Tennessee are from 50 to 70 miles wide and extend northeast and southwest across the State from Chattanooga on the south to Middlesboro, Ky., on the north. The coal-bearing areas comprise about 4,400 square miles, of which it is estimated about 47 per cent may contain coal of economic value.

The coal fields may for convenience be divided into a northern and a southern division. The northern area, which produces most of the coal mined, may be subdivided into the Jellico Basin, comprising parts of Campbell and Scott counties; the Wartburg Basin, including parts of Morgan, Anderson, and Scott counties; and the Middlesboro Basin, including Campbell and Claiborne counties. The southern division, which is known as the Chattanooga district, includes the Sewanee Basin, a part of the Cumberland plateau, the Walden Ridge Basin, and the Lookout Basin.

**CHARACTER OF COAL BEDS.**

The coal for the most part is bituminous throughout the State, but there is a limited area of cannel coal in the Jellico district. The beds, though reasonably uniform in thickness over limited areas, are relatively thin and the coal is variable in quality. The coal beds are nearly horizontal in most regions of extensive development except for local folds and rolls. The coals in the northern districts are a good grade of steam and domestic fuel, whereas in the southern districts the Sewanee coal is better adapted for coking purposes.

The Jellico coal in the Jellico district varies from 3 to 4 feet and the Blue Gem coal from  $1\frac{1}{2}$  to 2 feet. Many mines are operated in these two beds, but most of them are mines with a small output. The coal in the Middlesboro Basin varies from 4 to 5 feet in thickness and is extensively mined in Mingo Hollow and elsewhere. The coal in the Wartburg Basin is variable in thickness and quality, ranging from 3 to 5 feet in thickness.

The coal in the Chattanooga district is nearly horizontal except over local areas, as along Walden Ridge, where it is greatly disturbed. The Sewanee coal ranges from about  $2\frac{1}{2}$  to  $4\frac{1}{2}$  feet in thickness and is generally found badly crushed and contorted and sometimes intimately mixed with "rash," which in this crushed form is very difficult to separate from the coal.

**MINING METHODS.**

The earliest records for the production of coal in Tennessee are those of 1840, during which year 558 tons were mined. The production has gradually increased and in 1913 amounted to 6,903,784 tons. The mines are practically all opened by drifts, a few by slopes, and only two by shafts, and the coal is mined largely by the

room-and-pillar system. Few of the mines in the State are large producers and in many of them mule haulage alone is used. Roof conditions average fairly good when proper precautions are taken in timbering. About 57 per cent of the mines are ventilated by fans and about 30 per cent by furnaces. Most of the mines are wet and there is little chance for dust to gather, but some of them are very dry and considerable dust is produced in mining the coal. In a few of the dry mines adequate sprinkling cars are provided, but in two or three dry mines no attempt is made to sprinkle, and the mines are dangerously dusty.

There were 8 coal mining machines in use in 1897 and 252 in 1913. The amount of machine-mined coal for the latter year was 26.7 per cent of the total output, or 7,312 tons per machine. In 1912, 32.9 per cent of the coal mined was shot from the solid and in 1913, 37 per cent was mined by this method; 36.3 per cent was mined with hand picks.

As early as 1891 an agreement between mine operators and miners prohibited shooting coal off the solid, but this contract is too frequently broken in practice.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The first mine-inspection law of Tennessee was passed April 7, 1881. It required that all accidents at mines should be reported to the inspector of the district in which the mine was located, and, if fatal, to the county coroner. The enforcement of the law was intrusted to the geologist of the bureau of agriculture, statistics, and mines, with power to employ such assistants as were necessary. The inspector was required to preserve in his office a record showing the cause of all accidents in the mines. An act approved March 29, 1887, consolidated the inspection service and placed it under the jurisdiction of one mine inspector, whose office was maintained at Chattanooga, and to whom all accidents were to be reported by the mine operators. The inspector rendered annual reports to the governor on January 1 of each year. On March 23, 1891, an act was approved by which the office of mine inspector was consolidated with the bureau of labor and mining statistics, under the supervision of the commissioner of the bureau of labor, statistics, and mines. The scope of the work of the new bureau was made to include the inspection of all mines, collieries, mills, and factories, and all accidents at such establishments resulting in loss of life or serious personal injury were to be reported to the commissioner of the bureau, the commissioner to render annual reports to the Governor.

An act of April 3, 1903, separated the mine inspection service from the bureau of labor and mining statistics, established the office of chief mine inspector, and authorized the governor to appoint one



chief inspector and two district mine inspectors, the chief to specify the counties which should compose the two districts. The act applied to both coal and metal mines, and the chief inspector was required to render annual reports to the governor, and to enumerate therein all accidents, both fatal and nonfatal.

### ACCIDENTS.

Tables 128 and 129 show the production, number of men employed, and number killed in and about the coal mines of Tennessee as compiled from the reports of the United States Geological Survey and the State mine inspector's reports. Continuous records of fatalities have been kept since 1891 to the end of 1913. During this period there were 859 fatalities, representing a rate of 4.30 per 1,000 men employed. The amount of coal produced per fatality was 119,280 tons, or there were 8.38 fatalities per 1,000,000 tons mined. Of the total number of fatalities 42.03 per cent was due to falls of roof; 39.47 per cent to gas and dust explosions, whereas mine cars and locomotives caused 5.70 per cent, and explosives a like percentage.

FATALITIES IN **TENNESSEE** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1891 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	361	42.03	1.81
Mine cars and locomotives.....	49	5.70	.25
Gas and dust explosions.....	339	39.47	1.70
Explosives.....	49	5.70	.25
Miscellaneous.....	27	3.14	.13
Shaft.....	1	.12	.....
Surface.....	33	3.84	.16
Total, 23 years.....	859	100.00	4.30

COAL-MINE ACCIDENTS IN **TENNESSEE** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1895 Dec. 20.....	Nelson.....	Dayton.....	Mine explosion.....	25
1901 May 27.....	Richland.....	do.....	do.....	20
1902 Mar. 31.....	Nelson.....	do.....	do.....	16
1902 May 19.....	Fraterville.....	Coal Creek.....	do.....	184
1911 Dec. 9.....	Cross Mountain.....	Briceville.....	do.....	84

Since 1895 there have been five disasters in which 327 men were killed. A list of these disasters is given in an accompanying table.

Since 1903 slightly over one-half of the men have been employed at the mines on a 9-hour basis. During the 10-year period 1903 to 1913, excepting 1909, the men were employed 2,100 hours during the year. The fatality rate based on the actual number of employees as shown in Table 40 is 3.40, but when computed on the basis of equivalent 2,000-hour workers becomes 3.23. By comparing Tenn-



essee with Ohio on the basis of actual number of employees, it will be noted that the Tennessee rate is much higher, being 3.40 as compared with 2.94 for Ohio. The men in Ohio were employed 1,495 hours per annum, so that reducing the fatality rate to 2,000-hour workers the Tennessee rate is 3.23 as compared with 3.94 for Ohio. A similar comparison may be made with other States in tables 40 and 41.

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES OF **TENNESSEE.**<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	1	9	54	5,614	23	3,415	923	9,961
1904.....	8	657	63	6,102	24	2,887	770	10,416
1905.....	8	876	62	5,693	33	4,463	596	11,928
1906.....	4	246	79	6,938	30	4,034	234	11,452
1907.....	13	1,561	75	6,968	27	3,379	144	12,052
1908.....	5	287	87	8,220	19	1,921	1,384	11,812
1909.....								10,031
1910.....	5	451	86	7,566	32	3,395	518	11,930
1911.....	6	375	56	5,929	30	3,978	842	11,124
1912.....	5	317	77	5,720	29	3,980	292	10,309
1913.....	9	710	78	6,163	35	3,927	493	11,263

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **TENNESSEE** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	227	93,055	21,123,485	10,562	26	2.46
1904.....	217	95,974	20,826,358	10,413	28	2.69
1905.....	221	110,939	24,517,519	12,259	29	2.37
1906.....	229	106,856	24,470,024	12,235	32	2.62
1907.....	232	110,286	25,586,352	12,793	30	2.35
1908.....	209	107,942	22,559,878	11,280	34	3.01
1909.....						
1910.....	225	110,314	24,820,650	12,410	38	3.06
1911.....	232	103,719	24,062,808	12,031	111	9.23
1912.....	234	96,444	22,567,896	11,284	18	1.60
1913.....	241	104,584	25,204,744	12,602	35	2.78

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **TENNESSEE.**<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	1,595	37,085	23	1907.....	284	4,725	17
1900.....	1,559	67,308	43	1908.....	349	11,441	33
1901.....	1,705	82,730	49	1909.....	277	9,295	34
1902.....	1,904	136,347	72	1910.....			
1903.....	1,633	36,021	22	1911.....	163	1,630	10
1904.....	2,391	170,680	71	1912.....	670	20,011	30
1905.....	150	4,770	32	1913.....	857	42,966	50
1906.....	180	1,185	7	1914.....			

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.



1905.....	5,763,690	1.14	11,928	29	2.43	5.03	198,871	221	483	2.10	.....	8.3	.....	.....	77	12	.....	89
1906.....	6,236,273	1.22	11,452	32	2.79	5.11	195,092	220	507	2.49	.....	10.9	.....	.....	113	14	.....	138
1907.....	6,810,243	1.25	12,052	30	2.49	4.41	227,008	232	505	2.44	.....	12.9	.....	.....	120	14	.....	137
1908.....	6,190,171	1.15	11,812	34	2.88	5.48	182,329	209	525	2.51	.....	12.7	.....	.....	100	18	.....	122
1909.....	6,358,645	1.09	10,031	29	2.89	4.56	219,294	(a)	634	(a)	.....	16.4	.....	.....	119	54	.....	197
1910.....	7,121,380	1.11	11,430	38	3.19	5.34	187,405	225	597	2.65	.....	17.2	.....	.....	131	22	.....	178
1911.....	6,433,156	1.12	11,124	111	9.98	17.25	57,956	232	578	2.49	.....	25.2	.....	.....	121	15	.....	130
1912.....	6,113,258	1.14	10,369	18	1.75	2.78	359,624	234	638	2.68	.....	18.6	.....	.....	154	17	.....	119
1913.....	6,903,784	1.14	11,263	35	3.11	5.07	197,251	241	613	2.54	.....	33.7	.....	.....	176	21	.....	134
Total.....	123,793,965	.....	.....	859	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average (1891-1913).....	4,454,854	.....	8,689	37.35	4.30	8.38	119,280	228	513	2.25	.....	39.1	.....	.....	120	9	.....	144
1914.....	5,943,258	1.14	10,116	26	2.37	4.37	228,387	220	588	2.67	.....	37.6	.....	.....	1	54	.....	120

a Not reported.

TABLE 129.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN TENNESSEE, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1891 TO 1914, INCLUSIVE.

Year.	Killed underground.											Killed in shaft.					Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1891	12	1	1			5						1	19						3	3					3	22
1892	10	1	1			2						3	11						1	1					2	13
1893	13	3	2										12						1	1					2	13
1894	12												27												2	14
1895	5					2							37												1	27
1896	16		1		28								21												2	27
1897	10	2	1			1							17												1	22
1898	10	1	1	1									18							1	1				1	10
1899	13		3			1							17												2	19
1900	8	1	3			1							10												1	22
1901	16	1	1		20	3				1		1	43												2	43
1902	17	1	2		200	3							26												6	226
1903	15		2										20							6	6				6	26
1904	19		4		3	7							28												1	28
1905	20		2			3							28							1	1				1	29
1906	20		3			3						2	28							1	1				1	32
1907	19	1	3	3		1							29	1						1	1				1	30
1908	26	1				1			1				33							1	1				1	31
1909	26		4			3							27							1	1				1	32
1910	18		3			3							27							1	1				1	31
1911	22		3			10							37							1	1				2	38
1912	14		5		84			4					108							3	3				2	111
1913	23	1											16												1	18
1914	25	1	1										34												1	35
1914	19	2	1	1		1							24							2	2				2	26



**TEXAS.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal-bearing rocks that carry bituminous coal comprise an area in northern Texas a little more than 200 miles long and 45 miles wide, but coal beds are limited to an area of about 8,200 square miles in Wise, Palo Pinto, Erath, and McCulloch counties. The structure of this field is a gentle monocline, the beds dipping northwest about 100 feet to the mile.

In the southern part of the State, near Eagle Pass, Maverick County, is a Cretaceous coal bed which is mined to some extent.

The Tertiary lignite beds extend entirely across the State from Mexico to Arkansas; the known workable areas cover about 2,000 square miles, and there are about 53,000 square miles that may contain workable beds. Of the total amount of coal mined, about one-half is lignite.

**CHARACTER OF COAL BEDS.**

In the bituminous field there are three workable beds, but the ones most largely mined are No. 1, which is the lowest, and No. 7, which is the highest. These coals are of Carboniferous age. No. 1 is continuous for at least 80 miles, and in Wise County is 14 to 26 inches thick; in Park County, 18 to 26 inches thick; in Palo Pinto County, 26 inches thick; and in Erath County, 28 inches thick.

With few exceptions the coal bed has a strong shale roof and shale floor. The No. 7 bed has the same structural features as No. 1 and is continuous for about 250 miles. It is 12 to 42 inches thick. Near Cisco the bed is 33 inches thick.

In the lignite field the beds that are worked are thick, generally ranging from 6 to 8 feet.

**MINING METHODS.**

The earliest coal-production report for Texas was in 1884, when 125,000 tons of coal was mined. The production for 1913 was 2,429,144 tons. Of the 48 mines in operation in 1913, 8 were opened by slopes, and 43 were opened by shafts varying from 45 to 418 feet in depth. About one-half were opened by single entry and one-half by double entry. One-third of the mines are operated by the long-wall method, and two-thirds by the room-and-pillar method. Steam hoists are used at practically all of the mines. Electric and mule haulage are used underground, while 3 mines were using gasoline motors.

The majority of the mines are ventilated by fans and only two by furnaces. In 1897, there were 5 mining machines, and in 1913, 24 machines. In 1913, 61.5 per cent of the coal was mined by hand and 4.2 per cent by machines, and 25 per cent was shot off the solid.

**REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

The law enacted by the Texas Legislature April 30, 1907, authorized the governor to appoint a State mine inspector for all coal mines, upon the recommendation of an examining board, also provided for by the act. The first inspector was appointed September 30, 1909, and was directed to see that the provisions of the mining law were properly enforced. The law, however, did not require mine operators to report accidents to the State inspector.

**ACCIDENTS.**

Tables 130 and 131 show the production of coal and the number of men employed in the mines of Texas since 1889. Complete accident records, however, were not kept prior to 1909. During the 5-year period 1909-1913, there were 25 fatalities reported in and about the coal mines of Texas, representing a rate of 1.06 per 1,000 men employed. The amount of coal mined per fatality was 412,359 tons or 2.43 fatalities per million tons mined. Texas has been free from serious mine disasters.

FATALITIES IN **TEXAS** COAL MINES, BY PRINCIPAL CAUSES, DURING 5 YEARS 190 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 em- ployed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	16	64.00	0.67
Mine cars and locomotives.....	2	8.00	.09
Gas and dust explosions.....			
Explosives.....	2	8.00	.09
Miscellaneous.....	3	12.00	.13
Shaft.....	1	4.00	.04
Surface.....	1	4.00	.04
Total, 5 years.....	25	100.00	1.06

Since 1903, practically one-half of the men in the State have been employed on an 8-hour basis. Tables 40 and 41 have been compiled for comparative purposes. It will be noted that the employees of Texas worked 2,101 hours per year. The fatality rate for the period 1903 to 1913, inclusive, except 1909, based on the actual number of employees, is 1.08 per 1,000 men employed, and based on the 2,000-hour days becomes 1.05. This rate may be readily compared with rates of other States by referring to Table 41. The tables of statistics for the State follow:

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **TEXAS**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	3	71	6	1,185	6	573	541	2,380
1904.....	7	1,624	2	91	12	971	235	2,921
1905.....	11	1,442	3	125	13	1,135	306	3,008
1906.....	10	1,817			8	703	528	3,048
1907.....	5	1,453	1	60	16	2,202	512	4,227
1908.....	16	2,351	1	50	21	1,759	240	4,400
1909.....								4,196
1910.....	20	2,302	1	70	17	1,536	289	4,197
1911.....	16	3,007	3	179	18	1,649	115	4,980
1912.....	20	2,908	1	40	19	1,789	390	5,127
1913.....	19	2,727	8	525	11	1,299	550	5,101

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Including daymen who work 10 hours.

<sup>c</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **TEXAS** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day. (all employees.)	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000, 2,000-hour workers.
1903.....	242	21,922	5,305,124	2,653		
1904.....	220	25,636	5,639,920	2,820		
1905.....	238	26,765	6,370,070	3,185		
1906.....	227	26,318	5,974,186	2,987		
1907.....	244	38,792	9,465,248	4,733		
1908.....	254	39,008	9,908,032	4,954		
1909.....						
1910.....	234	37,007	8,659,638	4,329	7	1.62
1911.....	226	43,462	9,822,412	4,911	8	1.63
1912.....	230	45,024	10,355,520	5,177	2	.39
1913.....	253	44,481	11,253,693	5,626	4	.71

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **TEXAS**.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	185	2,775	15	1907.....	270	1,610	6
1900.....	135	2,740	20	1908.....	169	338	2
1901.....	113	226	2	1909.....	80	4,800	60
1902.....	50	50	1	1910.....	1,776	108,230	61
1903.....	1,055	24,460	23	1911.....	60	300	5
1904.....	55	585	11	1912.....	238	1,724	7
1905.....	25	375	15	1913.....			
1906.....	1,260	9,245	7	1914.....	221	693	3

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 130.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN TEXAS, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 compiled from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10, prior to 1900, calculated.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.
				Total.	Per 1,000 employed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial ax or post.	Total.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1884-1888.....	490,000																				
1889.....	128,216	\$2.65	543				(a)	236	274	1.14											
1890.....	184,440	2.53	674				241	274	1.14												
1891.....	172,100	2.40	787				225	219	.97												
1892.....	245,690	2.32	871				208	282	1.36												
1893.....	302,206	2.28	906				251	303	1.21												
1894.....	430,848	2.32	1,062				283	396	1.40												
1895.....	484,959	1.88	1,632				171	295	1.73												
1896.....	544,015	1.65	1,953				187	279	1.49												
1897.....	639,341	1.52	1,766				220	362	1.65		1.8								5		
1898.....	686,734	1.66	2,130				245	322	1.31		2.2								5		
1899.....	883,832	1.51	2,410				256	367	1.43												
1900.....	968,373	1.63	2,844				246	340	1.38										8		
1901.....	1,107,953	1.72	3,051				264	363	1.38		2.0										
1902.....	901,912	1.64	2,369				267	381	1.43		2.8										
1903.....	926,759	1.62	2,380				242	389	1.61		3.1				2				8		
1904.....	1,195,944	1.66	2,921				220	409	1.86		3.1				6	3			9		
1905.....	1,200,654	1.64	3,008				238	399	1.68		1.9				5	3			8		
1906.....	1,312,873	1.66	3,048				227	431	1.90		1.7				9	3			12		
1907.....	1,648,099	1.69	4,227				244	390	1.60		2.2				10	3			13		
1908.....	1,895,377	1.80	4,400				254	431	1.70		.8				6	6			6		
1909.....	1,824,440	1.72	4,196	4	0.95	2.19	(a)	435	(a)		.9				2	3			11	42	
1910.....	1,892,176	1.67	4,197	7	1.67	3.70	234	451	1.93		1.1				8	6			14	43	





## UTAH.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal-bearing areas of Utah comprise about 10,570 square miles, which are roughly divisible into three fields. The Wasatch field is the largest, and includes parts of Carbon, Emery, Grand, Uinta, and Wasatch counties. The next largest field is in the southern part of the State, and occupies the larger part of Garfield, Iron, and Kane counties. The other field is in Summit County, in northern Utah, and is relatively unimportant, although mining operations at Coalville have been carried on since 1870. The greatest amount of development has been in Carbon and Emery counties, Carbon County producing about 90 per cent of the coal mined in the State. The principal districts in Carbon County are Sunnyside, Kenilworth, Castlegate, Pleasant Valley, Spring Canyon, and Hiawatha-Black Hawk.

### CHARACTER OF COAL BEDS.

The coal and the associated rocks in the Wasatch field have been subjected locally to serious folding and displacements, but in general the deformation has been uniform, resulting in regular structure and low dips. In western Carbon County and in Emery County the coal-bearing rocks are highly folded and cut by numerous faults, which render mining expensive and uncertain. But in the eastern part of the developed field the coal either lies nearly flat or dips only  $3^{\circ}$  to  $7^{\circ}$ .

The beds as a rule are thinner in the eastern than in the western part of the field. The coal in two beds, both of which are mined, in the Sunnyside district is about 14 feet thick, whereas in some of the western districts, as at Kenilworth and Hiawatha, the coal of a single bed ranges from 15 to 20 feet thick.

The coal beds in general are not uniform in thickness over large areas and in many places are known to be very lenticular. Rolls and "horsebacks" are common in some districts and in many places the latter oftentimes cut out a considerable part of the coal bed.

The southern coal field has never been exploited on a commercial scale, but the coal ranges in thickness from 4 to 8 feet.

### MINING METHODS.

Coal was first mined on a commercial scale in Utah in 1870, when 5,800 tons was produced. The production in 1913 was 3,254,828 tons, and in 1914, 3,103,036 tons was mined. Most of the mines are opened by drifts, entries, or slopes, and the coal is mined by the room-and-pillar method. The principal mines are worked on the double-entry system and at one of the typical mines the rooms are 24 feet wide by 400 feet long, separated by 40-foot pillars. Wherever

the coal extends 7 to 9 feet in thickness the excess is left on the roof and is taken down only when the pillars are drawn. Most of the mines are comparatively dry and the coal yields considerable dust when mined. The State mining law requires extensive sprinkling systems in such mines and most of the operators rigidly observe the law. Coal is rarely shot from the solid and is usually undercut (by machine or hand pick) or sheared before being shot. Electric shot-firing systems are in common use.

Coal-mining machines were first introduced into Utah in 1896 and in 1913 there were 50 machines in operation. During 1913 the machine-mined coal equaled 19.2 per cent, coal mined by hand-pick methods equaled 74.2 per cent, and that shot from the solid equaled 4.2 per cent.

#### **REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.**

An act of Congress approved March 3, 1891, authorized the President of the United States to appoint a mine inspector for each Territory in which the aggregate annual production of coal exceeded 1,000 tons. Under the provisions of this law the first mine inspector for Utah was appointed August 23, 1892. Section 15 of the act provided that a full and written report of every fatal accident should be made to the mine inspector within 10 days after such death should occur. Annual reports for fiscal years ending June 30 were rendered to the Secretary of the Interior. Utah was admitted as a State in January, 1896, and under a law approved April 5, 1896, the first State inspector was appointed April 6. The State inspection law covered all coal and hydrocarbon mines employing more than six men, and the inspector was required to examine all such mines at least quarterly, and to render an annual report to the governor. Mine operators were required to report to the inspector every fatal accident within 10 days after the accident, and every nonfatal accident involving disability for one week or more. An act approved March 20, 1911, authorized the employment of a deputy inspector and repealed the provision of the previous laws limiting the inspection service to mines employing more than six men.

All accidents reported to the inspector by mine operators are published in the inspector's annual report, but only those involving disability for at least 30 days are classified as serious accidents.

#### **ACCIDENTS.**

Tables 132 and 133 show the number of men employed, the production of coal, and the number of fatalities as compiled from the best records available. The State mine inspectors' reports show fatal accidents back to 1892, and are complete from that year to



date. The total number of men killed during the period 1892 to 1913, representing 22 years, was 355 or 9.25 fatalities per 1,000

FATALITIES IN **UTAH** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1892 TO 1913, INCLUSIVE.

Causes.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	95	26.76	2.48
Mine cars and locomotives.....	25	7.04	.65
Gas and dust explosions <sup>a</sup> .....	205	57.75	5.34
Explosives <sup>b</sup> .....	5	1.40	.13
Miscellaneous.....	7	1.97	.18
Shaft.....	3	.84	.08
Surface.....	15	4.23	.39
Total, 22 years.....	355	100.00	9.25

<sup>a</sup> Includes Winter Quarters mine disaster at Scofield, May 1, 1900, in which 200 men were killed by a powder and dust explosion, representing 56.34 per cent of the fatalities, or 5.21 per 1,000 for the 22-year period.

<sup>b</sup> See footnote <sup>a</sup>.

COAL-MINE ACCIDENTS IN **UTAH** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.....May 1, 1900.  
 Name of mine.....Winter Quarters Nos. 1 and 4.  
 Location of mine.....Scofield.  
 Nature of accident.....Powder and mine explosion.  
 Number killed.....200.

men employed, of which number 57.75 per cent was due to gas and dust explosions. This includes the explosion at the Winter Quarters mine in 1900, in which 200 were killed at one time. This one disaster represents 56.34 per cent of the total fatalities during the 22-year period. Falls of roof represent 26.76 per cent, or 2.48 fatalities per 1,000 men employed. The quantity of coal produced per fatality was 89,252 tons, or 11.20 fatalities per million tons of coal mined.

Since 1903, the mines have been operated on an 8-hour basis, and for comparison with States having 9-hour and 10-hour working days, Tables 40 and 41 have been compiled. It will be noted that during the period 1903 to 1913, except 1909, the men were employed 2,109 hours per year. The fatality rate based on the actual number of employees is 4.15 per 1,000, whereas, when reduced to the uniform basis of 2,000-hour workers, it becomes 3.93, which compares favorably with the rate in Ohio, where the rate on the same basis is 3.94. Similar comparisons with other States may be made by reference to Table 41. The tables of statistics for the State follow.



NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **UTAH**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	12	158	4	1,747	3	9	11	1,925
1904.....	15	1,356	2	5	1	2	11	1,374
1905.....	13	1,352			2	6	3	1,361
1906.....	12	1,554	1	2	1	3	13	1,572
1907.....	16	2,046					157	2,203
1908.....	17	2,620			1	2	42	2,664
1909 <sup>b</sup> .....								3,014
1910.....	20	3,049					4	3,053
1911.....	21	3,056					390	3,446
1912.....	22	3,326	1	2				3,328
1913.....	23	4,063	2	95				4,158

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.      <sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **UTAH** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	248	17,176	4,259,648	2,130	7	3.29
1904.....	294	11,012	3,237,528	1,619	9	5.56
1905.....	247	10,903	2,693,041	1,347	7	5.20
1906.....	288	12,597	3,627,936	1,814	4	2.21
1907.....	258	17,781	4,587,498	2,294	5	2.18
1908.....	227	21,358	4,848,266	2,424	5	2.06
1909.....						
1910.....	260	24,428	6,351,280	3,176	18	5.67
1911.....	236	27,958	6,598,088	3,299	13	3.94
1912.....	285	26,626	7,588,410	3,794	19	5.01
1913.....	273	33,359	9,107,007	4,554	17	3.73

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN **UTAH**.

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....				1907.....	148	592	4
1900.....				1908.....			
1901.....	754	23,055	30	1909.....			
1902.....				1910.....			
1903.....	350	9,800	28	1911.....	208	624	3
1904.....				1912.....			
1905.....	6	6	1	1913.....	5	1,300	260
1906.....				1914.....	150	1,800	12

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





TABLE 133.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN UTAH, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE DURING THE CALENDAR YEARS 1892 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.
	Total.										Total.						Total.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	(Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and loco-motives.	Other causes.	
1892 <sup>a</sup> .....	1					1							2										
1893.....																							
1894.....	1																						
1895.....		1																					
1896.....	1																						
1897.....	1	1																					
1898.....	2		1																				
1899.....																							
1900.....	3	3	1	4	1	1					1	209											
1901.....	3	2	2									8											
1902.....	2				1							7											
1903.....	4		2									6											
1904.....	4	1	1									2	1										
1905.....	3											4											
1906.....	3		1	1								4	1										
1907.....	3											5											
1908.....	7	1	2									5											
1909.....	6	6	2									15											
1910.....	7	4	2		1						1	15											
1911.....	6	5	2									12											
1912.....	3	9	0			1	1					18											
1913.....	3				1							11	1										
1914.....	3								1			17											

<sup>a</sup> Sept. 28 to Dec. 31.<sup>b</sup> Probably originated by an explosion of powder magazine underground.<sup>c</sup> Inspector's report gives detailed description of 9 fatalities, while one table in his report shows 10 giving no details.



## VIRGINIA.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal-bearing area of Virginia comprises about 1,550 square miles in the Appalachian region, 200 square miles in the Brushy Mountain fields, and 150 square miles in the Atlantic Coast region. Of the latter, the larger part is in the Richmond Basin. This basin extends in a north and south direction through parts of Goochland, Henrico, Powhatan, and Chesterfield counties. It is about 30 miles long, with a maximum width of 10 miles, and its eastern edge is about 13 miles from Richmond. There are also one or two other isolated fields in the Atlantic coast region, but mining in these has been of little importance.

The Brushy Mountain fields include long narrow strips of coal-bearing rocks nearly across the State. These rocks are of lower Carboniferous age and are some of the oldest coal-bearing strata known in this country. Some of the coal is of the semianthracite rank.

The Appalachian region includes a large area in the southwestern part of the State, with the principal mines in Wise, Russell, Tazewell, and Lee counties. More than one-half of the coal mined in the State comes from Wise County. The coal-bearing rocks lie in a broad, flat, synclinal trough lying between the southeastern edge of the coal field and Pine Mountain. In the middle of the trough the beds are generally flat, except where they are disturbed by small folds and faults. On the edges of the trough the beds are strongly tilted, in some places even standing vertical.

### CHARACTER OF COAL BEDS.

The coal in the Richmond Basin is a bituminous coking coal. The coal beds are steeply inclined and are 4 to 30 feet thick, and in a number of places have been cut by intrusions of diabase, producing natural coke. It has been estimated by Shaler and Woodworth that at a distance of one mile from the outcrop the depth of the beds is 2,500 feet, and it is possible that the beds may extend to a depth of 4,000 feet. The coal beds are broken by faults that make systematic mining difficult.

The coal beds in the Brushy Mountain fields range from 3 to 12 feet in thickness, but the beds contain many partings of shale which make mining expensive and the products of the mines difficult to market. Although desultory mining has been done on these coal beds for a long time, only a little coal has reached the market.

In the main bituminous field the coal beds are much more numerous and valuable. In Lee County 12 beds of coal are of workable

thickness, ranging from  $2\frac{1}{2}$  to 6 feet thick. In the Big Stone Gap district the most important coal bed is the Imboden, which ranges from 4 to 13 feet in thickness. There are also a number of beds from 4 to 8 feet thick lying above the Imboden.

On Toms Creek the Upper Banner coal, ranging from 5 to 8 feet thick, is the most important bed. This bed has a shale roof and a hard shale floor.

In Dickenson County the coal beds below the Gladeville sandstone are thin, but above that sandstone 10 beds are recognized, which range in thickness from 2 to 12 feet. The Lower Bolling bed is 4 feet thick with shale roof and clay floor. The Glamorgan bed is  $4\frac{1}{2}$  feet thick with shale roof and shale floor. The Pardee bed is about  $9\frac{1}{2}$  feet thick.

#### MINING METHODS.

Coal was first mined in the Richmond Basin in 1750. In 1789 regular shipments were made. Production records begin with 1822 with 5,400 tons. The larger mines are opened by slopes and vertical shafts, the latter being 400 to 500 feet deep. In the earlier days colored labor was employed under the supervision of English and Welsh miners, and the mining systems were largely adapted from English practices. In recent years Hungarian and colored labor is employed, largely under the direction of local or Pennsylvania managers. With the development of the southwestern Virginia field the Richmond Basin remained practically dormant after 1883. Renewed activity has prevailed during the last 4 years.

As in West Virginia, the room-and-pillar method of mining prevails largely throughout the Appalachian region with practically all of the mines opened by drift entries. In 1887 there were only 8 mining machines in operation, but in 1913 there were 187 machines, producing 47.6 per cent of the coal; 19.7 per cent was mined by hand, and 32.6 per cent shot off the solid. The production per man in 1913 was 964 tons.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The mine-inspection service of Virginia was established in accordance with an act approved March 13, 1912, applying to all coal mines in which five or more persons were employed in a period of 24 hours. The appointment of the inspector was vested in the commissioner of the bureau of labor and industrial statistics, to whom the inspector was required to render annual reports for years ending June 30. Mine operators were required to report to the inspector all accidents

causing loss of life or serious personal injury, stating the cause of such accident, and the inspector, if he deemed it necessary from the facts reported, was required to visit the scene of the accident and render such assistance and advice as he deemed necessary for the future safety of the men.

No rules have been adopted by the Bureau of Labor as to what constitutes a serious injury such as the law requires shall be reported to the inspector, but all accidents of which the inspector receives notice are included in his annual report to the commissioner.

In 1915 one coal-mine inspector was employed.

### ACCIDENTS.

Tables 134 and 135 show the production of coal beginning with 1822, the number of employees beginning with 1888, and the number of fatalities from 1909 to date. Although Virginia was one of the first States to produce coal, yet systematic records of accidents in that State have not been kept until recent years. There have been a number of serious mine explosions, extending as far back

FATALITIES IN **VIRGINIA** COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1909 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.).....	131	52.19	3.33
Mine cars and locomotives.....	32	12.75	.81
Gas and dust explosions.....	25	9.96	.63
Explosives.....	10	3.98	.25
Miscellaneous.....	34	13.55	.86
Shaft.....	1	.40	.03
Surface.....	18	7.17	.46
Total, 5 years.....	251	100.00	6.37

COAL-MINE ACCIDENTS IN **VIRGINIA** IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1839 Mar. 18.....	Black Heath.....	Near Richmond.....	Mine explosion.....	40
1854 .....	Chesterfield.....	do.....	do.....	19
1855 .....	Midlothian.....	Coalfield.....	do.....	55
1876 May 20.....	do.....	do.....	do.....	8
1882 Feb. 3.....	do.....	do.....	do.....	32
1884 Mar. 13.....	Laurel.....	Pocahontas.....	do.....	112
1901 Nov. 14.....	Pocahontas.....	do.....	Mine fire and explosion.....	9
1901 Nov. 22.....	do.....	do.....	Mine fire.....	8
1906 Oct. 3.....	do.....	do.....	Mine explosion.....	35
1907 Mar. 16.....	Bond and Bruce.....	Tacoma.....	do.....	11
1910 Dec. 14.....	Greeno.....	do.....	do.....	8
1911 Jan. 20.....	Carbon Hill.....	Carbon Hill.....	do.....	5
1912 Jan. 16.....	do.....	do.....	Dynamite explosion.....	5
1912 July 16.....	Old Dominion No. 1.....	do.....	Mine explosion.....	8



as 1839, as shown in the accompanying list. During the five years, 1909 to 1913, for which continuous records are available, there have been 251 fatalities, representing 6.37 fatalities per 1,000 men employed. The quantity of coal produced per fatality was 138,644 tons, or 7.21 fatalities per million tons of coal mined. Of the total number of fatalities during the 5-year period, 52.19 per cent was due to falls of roof-and-pillar coal, 12.75 per cent to mine cars and locomotives, and 9.96 per cent to gas and dust explosions.

Practically all of the men employed in and about the coal mines in Virginia are on a 10-hour basis, hence to permit comparisons with States on the 8-hour or the 9-hour basis, Tables 40 and 41 have been compiled. The number of hours worked per man a year in Virginia is 2,447 as compared with 2,132 hours in West Virginia, and 1,495 hours in Ohio. In order that true comparisons may be made with reference to the hazard of the mining industry, the time element has been taken into consideration and rates worked out on the basis of the number of 2,000-hour workers, as shown in Tables 40 and 41. Based on the actual number of employees, the rate for the 4 years 1910 to 1913 is 6.74 per 1,000. This reduced to the basis of 2,000-hour workers becomes 5.26 per 1,000, as compared with 5.18 for West Virginia, and 3.94 for Ohio. Table 41 shows figures for the other States worked out on a similar basis, so that comparisons may be readily made. The tables of statistics for the State follow.

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN VIRGINIA.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	2	250	4	21	21	5,032	305	5,608
1904.....	2	256	6	372	24	4,092	445	5,165
1905.....	2	522	7	591	25	3,999	618	5,730
1906.....	6	105	5	727	31	4,294	5	5,131
1907.....	.....	.....	7	849	42	5,791	30	6,670
1908.....	2	112	10	802	32	5,214	80	6,208
1909 <sup>b</sup> .....	.....	.....	.....	.....	.....	.....	.....	6,191
1910.....	1	189	10	1,021	45	5,710	344	7,264
1911.....	2	43	4	33	52	6,929	1,102	8,107
1912.....	2	24	3	41	49	8,181	432	8,678
1913.....	1	32	8	302	49	8,743	85	9,162

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.



NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN VIRGINIA AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	267	55,254	14,752,818	7,377	.....	.....
1904.....	238	50,321	11,976,398	5,988	.....	.....
1905.....	241	55,047	13,266,327	6,633	.....	.....
1906.....	250	50,368	12,592,000	6,296	.....	.....
1907.....	241	65,821	15,862,861	7,931	.....	.....
1908.....	200	60,974	12,194,800	6,097	.....	.....
1909.....	.....	.....	.....	.....	.....	.....
1910.....	241	70,897	17,086,177	8,543	57	6.67
1911.....	261	79,849	20,840,589	10,420	68	6.53
1912.....	251	86,259	21,651,009	10,826	75	6.93
1913.....	280	91,169	25,527,320	12,764	24	1.88

TABLE 134.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN VIRGINIA, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U. S. Geol. Survey. Figures in column 4 beginning with 1909 compiled from State mine inspectors' reports. Figures in columns 5, 6, and 7, and averages in columns 9 and 10 prior to 1900, calculated. Figures in italics represent incomplete fatality records.]

Year.	Production (short tons).	Value per ton at mine.	Number employed.	Number killed.			Production per death (short tons).	Days worked.	Average tonnage per man.		Percentage coal mined by—				Number and kind of machines.						Number of mines.
				Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.			Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported.	Pick.	Chain breast.	Long wall.	Short wall.	Radial ax or post.	Total.	
1822-1887	14,567,029			296				8	9	10	11	12	13	14	15	16	17	18	19	20	21
1888.	1,073,000	\$1.00	2,400					(a)	447												
1889.	865,786	.93	1,523					(a)	568												
1890.	784,011	.75	1,295					296	605	2.04											
1891.	736,399	.83	820					246	898	3.65											
1892.	675,205	.86	836					192	808	4.21											
1893.	820,339	.84	961					253	854	3.38											
1894.	1,229,083	.76	1,635					234	752	3.21											
1895.	1,368,324	.63	2,158					225	634	2.82											
1896.	1,254,723	.68	2,510					198	500	2.53											
1897.	1,598,302	.67	2,344					213	652	3.06		21.2								8	
1898.	1,815,274	.59	1,855					230	979	4.26		13.5								8	
1899.	2,105,791	.62	1,960					252	1,074	4.26		23.1			8						
1900.	2,393,754	.89	3,631					239	659	2.76		9.7								9	
1901.	2,725,873	.86	4,152					279	657	2.35		8.6								6	
1902.	3,182,993	.80	3,912					293	814	2.78		4.2								11	
1903.	3,451,307	.96	5,698					267	615	2.30		2.4				10 <sup>1</sup>				10	
1904.	3,410,914	.86	5,165					238	660	2.77		7.2			3	15				18	
1905.	4,275,271	.88	5,730					241	746	3.10		9.3			10	25				35	
1906.	4,254,879	.98	5,131					250	829	3.32		10.0			10	27				37	
1907.	4,710,895	1.02	6,670					241	706	2.93		16.7			26	51				77	
1908.	4,259,042	.91	6,208					200	686	3.43		24.3			14	71				85	
1909.	4,752,217	.89	6,191	27	4.36	5.68	176,008	(a)	768	(a)		27.9			21	82	4	6		107	62
1910.	6,507,997	.90	7,264	57	7.85	8.76	114,175	241	896	3.72		35.1			14	118				142	63

1911.....	6,844,667	.91	8,107	68	8.39	9.91	100,951	261	847	3.25	27.2	37.1	35.6	0.1	.....	121	.....	35	.....	156	61
1912.....	7,846,638	.96	8,678	75	8.64	9.56	104,622	251	994	3.60	11.5	40.8	47.7	.....	5	128	1	51	.....	185	61
1913.....	8,828,068	1.01	9,162	24	2.62	2.72	367,836	280	964	3.44	19.7	47.6	32.5	.1	4	106	1	76	.....	187	60
Total 1909-1913.....	96,287,781	.....	.....	580	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average 1913.....	6,959,917	.....	7,880	50.20	6.37	7.21	138,644	259	883	3.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1914.....	7,939,535	1.01	9,183	27	2.94	3.39	294,798	235	867	3.60	18.0	51.4	36.5	0.1	4	75	5	98	.....	182	63

a Not reported.

TABLE 135.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN VIRGINIA, <sup>a</sup> WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1909 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.		
											Total.						Total.							Total.	
	Falls of roof (coal, rock, etc.).	Falls on face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.			Railway cars and loco-motives.
1909.....	16				10					3		11	27							1					
1910.....	35		1						3			2	54							4			2		3
1911.....	35		18	5									60							1					8
1912.....	33		9	10		10		4	1				67	1					1	3	1		1		7
1913.....	11	1	4					4			1	3	24							5					24
1914.....	12	1				1		1					15	1	1				2						10
1915.....	27																								27

<sup>a</sup>Figures for 1909 are from Mineral Resources, U. S. Geol. Survey; 1910, 1911, and 1912 from reports of mine operators as received by the Bureau of Mines.

## WASHINGTON.

### AREA AND DISTRIBUTION OF COAL FIELDS.

The coal fields of Washington comprise an area of about 1,800 square miles in the northwestern part of the State. They may be grouped into four fields, as follows: North Puget Sound, including Whatcom and Skagit counties; south Puget Sound, including King and Pierce counties; Roslyn Basin, in Kittitas County; and the southwestern field, including Lewis and Cowlitz counties. King, Kittitas and Pierce counties are the principal producers.

The north Puget Sound field extends from the coast south of Bellingham northeastward to the foot of Mount Baker. It is the south limb of a great syncline. The coal beds dip to the northwest at varying angles, ranging from  $35^{\circ}$  near the coast to  $90^{\circ}$  at Cokedale and  $45^{\circ}$  at Glacier. The quality of the coal ranges from coking bituminous coal at Cokedale and Blue Canyon to anthracite at Glacier.

The south Puget Sound field is characterized by a series of parallel folds, usually in a north-south direction. The principal mines at Wilkeson and Carbonado are on the west slope of an anticline, where there are a number of overthrust faults. The structure in this field is complicated by folding and faulting and the intrusion of igneous rocks.

The Roslyn field, in Kittitas County, is a more regular basin, with a slight pitch to the southeast. The dip of the coal-bearing rocks varies from  $10^{\circ}$  to  $20^{\circ}$ , and the basin is free from faults.

The southwestern field is in general a broad, flat basin, but on the east side, next the Cascade Range, the coal beds are badly covered by lava flows. Here the coal is of low rank, being classed generally as the lowest grade of subbituminous coal.

### CHARACTER OF COAL BEDS.

The coals of Washington vary from lignite through semibituminous to bituminous coking coal. In a number of the districts the coal produces a large amount of slack or fine coal when mined.

Near Bellingham the coal bed that is now worked is 14 feet thick, whereas at Cokedale there are beds 20 feet thick. Gas is prevalent in these mines. The Blue Canyon bed has an average thickness of 7 feet, and at Glacier it is about 6 feet thick, but badly crushed and distorted.

The coal beds in the South Puget Sound field are more numerous, but the strata are so disturbed that coal beds can seldom be identified from mine to mine, even though the properties are contiguous and in some cases the mine workings connect. The center of production in King County is about Black Diamond. The principal beds here are the Upper McKay, which ranges from 4 feet 4 inches to 4 feet 9



inches, and the Lower McKay, which is 4 feet 7 inches to 6 feet 3 inches in thickness. At New Castle there are four productive beds, varying from 4 to 12 feet in thickness, some of which have been worked down the dip to a depth of about 2,000 feet. At Renton there are two beds, varying from  $7\frac{1}{2}$  to 8 feet in thickness. The most important producing area in Pierce County includes the mines on Carbon River from Wilkeson on the north to Montezuma on the south. At Wilkeson there are three coal beds, averaging each about 6 feet thick. At Carbonado at least 10 coal beds, which range in thickness from 2 feet to more than 8 feet, have been worked. The Wingate bed, about 5 feet thick, is the best in the mine. The Carbonado mine has considerable gas, especially on the west side of Carbon River.

In Kittitas County the mines are gaseous, one disastrous explosion occurring during 1910, in which 10 men lost their lives. Another explosion occurred in 1902. At Roslyn coal is being mined from beds 4 feet 6 inches thick from a shaft 604 feet deep. The roof consists of shale. At Clealum, in the same district, coal is being mined from a bed 4 feet 2 inches thick at a depth of 250 feet.

#### MINING METHODS.

The coal beds are faulted and upturned in many sections, so that it is necessary to mine coal from steeply inclined seams. The mines are opened by shafts, slopes, and drifts. In the Roslyn field the beds are very dry and require sprinkling to prevent the accumulation of dust. The double-entry room and pillar systems of mining are used. At Carbonado the mines are opened by slopes and drifts, some of which extend nearly 2 miles into the mountain side.

A number of the larger collieries in Washington have opened their mines by slopes and the coal is mined by the pillar-and-breast system, about 90 per cent of the coal being extracted. In the northern field the coal beds are opened by shafts and drifts and in some cases the coal seams are gaseous.

In 1896 there were three mining machines in use, producing only 3 per cent of the coal. The number of machines remained about the same until 1909, when there were 18 machines, and in 1913 there were 63 machines, producing 7.2 per cent of the total coal. Shooting off the solid is used for more than one-third the total production.

#### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

An act approved November 28, 1883, effective January 1, 1884, authorized the governor of the Territory of Washington to appoint an inspector of coal mines for all mines employing more than 10 men. In addition to rendering an annual report to the governor, the inspector was required to make a special report on all accidents

causing loss of life or serious bodily injuries. Operators were required to notify the inspector and coroner of all fatal accidents, and upon such notice an investigation was conducted to determine the cause of the accident. The act of February 4, 1886, required operators to notify the inspector of all serious accidents as well as fatal accidents.

On February 2, 1888, an act was approved by which the Territory was divided into two inspection districts, with an inspector for each district appointed by the governor. The State legislature enacted a law which was approved March 5, 1891, relating to the inspection of coal mines, but the requirement as to the reporting of fatal and serious accidents was not changed. The inspectors were appointed by the governor upon the recommendation of an examining board, and were required to file annual reports with the secretary of state before February 1, covering the previous calendar year.

The act of March 6, 1897, provided that the inspection law should apply to all coal mines employing 10 or more men, but that operators of mines employing less than 10 men should notify the inspector as soon as 10 men were employed.

On March 5, 1907, a law was approved providing one mine inspector for the entire State until there are 60 mines in operation, and dividing the State into districts, containing not less than 10 nor more than 60 mines each, and an inspector for each district, as soon as the number of operating mines in the State exceeds 60. An act approved March 13, 1911, authorized the State mine inspector to appoint, with the consent of the governor, a deputy inspector, who should hold office during the pleasure of the State inspector.

Prior to 1912 it was the practice of the operators to report only those injuries causing at least 30 days' disability, but since that year, when the workmen's compensation law became effective, the operators have reported all injuries resulting in disability for 5 days or more and these are published in the inspector's annual reports. Serious injuries are those resulting in 30 days' disability, all others being considered slight injuries.

In 1915 the inspector was assisted by one deputy.

#### ACCIDENTS.

Tables 136 and 137 show the production of coal, the number of men employed, and the fatalities in coal mines as compiled from the reports of the United States Geological Survey and the State mine inspectors' reports. Complete records of fatalities from the mine inspectors' reports are available from 1889 to 1913, a period of 25 years. During this time there were 640 fatalities, representing a rate of 6.14 fatalities per 1,000 men employed. The amount of coal produced per death was 93,606 tons, or 10.68 fatalities per

**FATALITIES IN WASHINGTON COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1889 TO 1913, INCLUSIVE.**

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.)	182	28.44	1.75
Mine cars and locomotives	81	12.65	.78
Gas and dust explosions	195	30.47	1.87
Explosives	32	5.00	.30
Miscellaneous	102	15.94	.98
Shaft	13	2.03	.12
Surface	35	5.47	.33
Total, 25 years	640	100.00	6.14

**FATALITIES DUE TO THE DIP OR PITCH OF COAL SEAMS IN WASHINGTON MINES, 1905 TO 1912, INCLUSIVE.<sup>a</sup>**

Cause of accident.	1905	1906	1907	1908	1909	1910	1911	1912
Coal or rock sliding down pitch	3	1	4	2	1	1	2	2
Timber sliding down pitch			4	1				
Runaway cars, and men falling from cars or skips	2	7	3	5	1	3	5	
Cars on haulage planes		2					1	
Falling down slopes or chutes				1	2	2	3	3
Suffocated by gas outburst		1			2			
Total	5	11	11	9	6	6	11	5
All fatalities	12	22	36	25	39	43	27	14

<sup>a</sup> Compiled from State mine inspector's reports.

**COAL-MINE ACCIDENTS IN WASHINGTON IN WHICH 5 OR MORE MEN WERE KILLED.**

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1892 May 10.	Roslyn.	Roslyn.	Mine explosion.	45
1894 Aug. 24.	Franklin.	Franklin.	Mine fire.	37
1895 Apr. 8.	Blue Canyon.	Lake Whatcom.	Mine explosion.	23
1899 Dec. 9.	Carbon Hill No. 7.	Carbonado.	do.	31
1900 Aug. 21.	Issaquah No. 4.	Issaquah.	Smoke from burning air shaft.	5
1902 Oct. 1.	Lawson.	Black Diamond.	Mine explosion.	11
1904 Dec. 7.	No. 5.	Burnett.	do.	17
1907 Apr. 26.	Morgan.	Black Diamond.	do.	7
1909 Oct. 3.	Northwestern.	Roslyn.	do.	10
1910 Nov. 6.	Lawson.	Black Diamond.	do.	16
1915 Nov. 16.	Northwestern.	Ravensdale.	do.	31

million tons of coal mined. During this period there have been 10 mine disasters in which 5 or more men have been killed at one time, making a total of 202 fatalities. Of the total number of fatalities during this 25-year period 30.47 per cent was due to gas and dust explosions; 28.44 per cent to falls of roof and coal; and 12.65 per cent to mine cars and locomotives.

Practically all of the mines in Washington are operated on an 8-hour basis, and for purposes of comparison with 9 and 10 hour States, Tables 40 and 41 have been compiled. The number of hours worked per year per man is 2,023. The fatality rate based on the actual number of employees is 4.64, as compared with 4.58 when



reduced to the equivalent of 2,000-hour workers. Table 41 gives similar data for all of the States, so that comparisons of one State with another may be readily made.

NUMBER OF HOURS TO THE WORKING-DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN **WASHINGTON**.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	5	342	17	2,245	6	2,180	.....	4,768
1904.....	24	4,152	4	70	.....	.....	1,065	5,287
1905.....	18	3,644	1	28	8	353	740	4,765
1906.....	29	4,179	4	106	2	13	231	4,529
1907.....	41	5,594	1	5	.....	.....	346	5,945
1908.....	39	4,665	1	20	.....	.....	799	5,484
1909 <sup>b</sup> .....	.....	.....	.....	.....	.....	.....	.....	5,992
1910.....	40	6,129	.....	.....	.....	.....	185	6,314
1911.....	45	5,642	.....	.....	.....	.....	1,594	7,236
1912.....	42	5,344	.....	.....	2	50	125	5,519
1913.....	52	5,794	.....	.....	.....	.....	.....	5,794

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN **WASHINGTON** AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	285	44,751	12,754,035	6,377	25	3.92
1904.....	243	43,431	10,553,733	5,277	31	5.87
1905.....	227	39,594	8,987,838	4,494	12	2.67
1906.....	266	36,595	9,734,270	4,867	22	4.52
1907.....	273	47,911	13,079,703	6,540	37	5.66
1908.....	202	44,691	9,027,582	4,514	25	5.54
1909.....	.....	.....	.....	.....	.....	.....
1910.....	256	50,697	12,978,432	6,489	43	6.63
1911.....	225	59,482	13,383,450	6,692	27	4.03
1912.....	226	44,377	10,029,202	5,014	14	2.79
1913.....	260	46,352	12,051,520	6,026	22	3.65

On account of the coal beds being badly upturned, necessitating working on steep pitches or dips, there is an unusual percentage of accidents due to coal, rock, or timber sliding down from a working face, from cars getting loose and running down an incline, and from men falling down chutes or slopes. About 30 per cent of the fatalities belong to this group, as shown in the accompanying table. In nearly all of the States, the bituminous coal beds are comparatively flat, but Washington is an exception in this respect. Outside of certain fields in Oklahoma and Colorado, and the anthracite fields in eastern Pennsylvania, there is not a district where the coal beds are as steeply inclined as in Washington. The tables of statistics for the State follow:



STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN  
WASHINGTON.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....				1907.....	484	8,544	18
1900.....	100	3,000	30	1908.....	226	67,800	300
1901.....				1909.....	123	2,300	19
1902.....				1910.....	101	303	3
1903.....	200	6,600	33	1911.....	2,099	22,215	10
1904.....	365	25,020	69	1912.....	807	31,347	39
1905.....				1913.....	1,239	60,145	49
1906.....				1914.....	459	25,410	55

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

TABLE 136.—PRODUCTION, NUMBER OF MEN EMPLOYED, AND NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN WASHINGTON, BY CALENDAR YEARS. ALSO TONNAGE MINED PER MAN, AS WELL AS THE NUMBER AND KIND OF MINING MACHINES IN USE.

[Figures for total production and all items below horizontal lines in various columns selected from Mineral Resources, U.S. Geological Survey. Figures in column 4 and items above horizontal lines in columns 2, 3, and 21 are from State mine inspectors' reports. Figures in columns 5, 6, and 7 and averages in columns 9 and 10 prior to 1900 calculated.]

1909.....	3,602,283	2.54	5,992	39	6.51	10.83	92,366	( <sup>b</sup> )	601	( <sup>b</sup> )	2.42	1.4	15	3	18	46
1910.....	3,911,869	2.30	6,314	43	6.81	10.99	90,974	256	620	2.42	1.4	10	10	23	48	
1911.....	3,572,815	2.29	7,296	27	3.73	7.56	132,326	225	494	2.20	62.9	5.3	27.6	4.2	29	50
1912.....	3,360,982	2.39	5,519	14	2.54	4.17	240,067	226	609	2.69	36.3	7.7	32.8	.2	56	48
1913.....	3,877,891	2.38	5,794	22	3.80	5.67	176,268	260	669	2.57	54.7	7.2	37.8	.3	61	53
Total.....	64,459,440			649												
Average (1889-1913).....	2,396,305	2.20	4,167	25.60	6.14	10.68	93,606	248	575	2.32						
1914.....	3,064,820		5,805	17	2.93	5.55	180,284	191	528	2.76	41.8	10.7	47.1	.4	1	58

<sup>a</sup> Report not available.

<sup>b</sup> Not reported.

TABLE 137. NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN WASHINGTON, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1885 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	(Ages or skips.	(Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.
1885	1		1			2						3	3	1					1							3
1886												1	1													2
1887	1																									1
1888 <sup>a</sup>												4	4													2
1889	1			1																						1
1890			1	2		1	1																			6
1891	1		1									1	1													1
1892	4	2	2	46									5	11	1	1			1	1						2
1893	2		2										1	53												1
1894	2	1	1	26	4	1					37	1	1	49	7				1	1						1
1895	2	1	1			1					4	1	1	36	1			1	1							1
1896	2	1	1			1								8												1
1897 <sup>b</sup>	2	1	1											10												1
1898	2	1	1	1	31	1						2	2	12	1											1
1899	1	1	1	4										44												1
1900	1	1	1	2		2	3				5	2	28	2												1
1901	1	1	1			2					1			23	1											1
1902	1	1	1		11	2							30	2	1											1
1903	10	1	1			3	1						30	1	1											1
1904	1	1	1	17		1							30	2	1											1
1905	1	1	1			1							12	1												1
1906	1	1	1	1		5						1	18	1												1
1907	10	1	1	10									32	2												1
1908	13	1	1	1								1	25	1												1
1909	9	1	1	14		3						2	37	1												1
1910	8	2	2		18	4					1	2	41	1												1
1911	2	3	3			1						2	23	1												1
1912	2	3	3			1						1	33	1												1
1913	2	3	3			1							21	1												1
1914	2	2	2	5	1	3						1	16	1												1

b Figures are from Feb. 2 to Dec. 31.

a Report not available.



**WEST VIRGINIA.****AREA AND DISTRIBUTION OF COAL FIELDS.**

The coal fields of West Virginia occupy all of the area on the Western slope of the Appalachian Mountains. The entire area of the State is 24,022 square miles, of which an area of approximately 17,000 square miles is coal-bearing. Thirty counties are important producers. The 6 counties heading the list, in the order of their production in 1913, are McDowell, Fayette, Marion, Harrison, Kanawha, and Logan, each of which mined more than 4,000,000 tons of coal.

There are seven important fields, the three in the northern part of the State being (1) Fairmont field, including Harrison and Monroe counties; (2) Elk Garden (Piedmont), or Upper Potomac field, including Mineral, Grant, and Tucker counties; (3) Phillippi field, including Preston, Barbour, and Randolph counties. The four fields in the southern part of the State are as follows: (1) New River field, including Fayette and Raleigh counties; (2) Kanawha field, including Kanawha and parts of Boone and Putnam counties; (3) Pocahontas field, including McDowell and Mercer counties, W. Va., and Tazewell County, Va.; and (4) Big Sandy field, which is a continuation of the Kanawha district into Logan and Mingo counties.

In general the coal beds and the associated sandstones, limestones, and shales of the West Virginia fields dip northwestward toward the axis of the great Appalachian trough, which passes through the northwestern part of the State from the southwest corner of Pennsylvania to Wayne County on Big Sandy River. Notwithstanding the general regularity of this great trough, the southeastern side, especially in northern West Virginia, is affected by a number of anticlinal folds trending in the same direction as the axis of the great trough. These smaller folds cause the dips in places to be much steeper than the normal, and on the southeast flank of the arch, to be toward the southeast. This is well illustrated in the synclinal trough in Preston County east of the Chestnut ridge anticline.

**CHARACTER OF COAL BEDS.**

All of the West Virginia coal is bituminous or semibituminous, the majority of which is of high rank.

The coal increases in rank from west to east across the State, the semibituminous coals being limited to small fields along the margin of the area. These fields of semibituminous coal are Pocahontas, New River, and Upper Potomac (Georges Creek). These coals are preeminently steam coals, going into the market as "smokeless," but they also are used to a limited extent in coke making.

The most important coal in the Fairmont and Elk Garden districts is the Pittsburgh (Elk Garden or 14-foot) bed, with an average

thickness of 8 feet 6 inches, of which 7 feet is usually mined. The Waynesburg and Sewickley coal beds occur in the Fairmont district, but are little worked. They vary in thickness from 5 to 10 feet. The Elk Garden district also contains the Thomas or Upper Freeport,  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet thick, and the Davis (Upper Kittanning or "Six-Foot") bed, varying from 4 to 11 feet in thickness. In the Kanawha district, the most important beds are "No. 2 Gas" and the Eagle (soft coking coal), varying in thickness from 3 to 5 feet, and the Coalburg and No. 5 (splint coal), varying from 4 to 6 feet thick.

In the New River field the principal beds are the Sewell, varying in thickness from  $3\frac{1}{2}$  to 5 feet; Fire Creek, averaging 3 feet, and the Beckley, varying from 4 to 6 feet. The Pocahontas field produces coal from the "No. 3" bed, which is 4 to 11 feet thick, averaging about 6 feet. In recent years considerable development work has been done on the "No. 4" and also on the Sewell bed.

### MINING METHODS.

The earliest records showing coal production of West Virginia are for 1863,<sup>a</sup> during which year West Virginia became a State, and 444,648 short tons was mined. This tonnage has gradually increased until in 1913 the production amounted to 71,308,982 short tons.

As the majority of the beds outcrop at various places, nearly all of the mines are opened by drifts or slopes, few shafts being necessary for mining operations. The room-and-pillar method of mining is extensively used. In 1913, there were 1,479 locomotives in use in the mines, of which 1,365 were electric, 46 steam, 40 compressed air, and 28 gasoline.

Mining in the Elk Garden district began in 1881. In 1891, there were 8 machines used in the State of West Virginia, and this number has gradually increased until in 1913 there were 2,541 machines in use. The average production per machine in 1913 was 15,116 tons. About one-half of the machines used are of the chain-breast type. Of the total amount of coal mined, 55.3 per cent in 1913 was mined by machines; 43.6 per cent was mined by hand, and only 0.8 per cent was shot off the solid.

### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

An act approved March 11, 1879, authorized the judge of any circuit court in any county to appoint a mine inspector for such county, upon a petition signed by 100 voters showing that any coal mine employing more than 10 men was not sufficiently ventilated. Inspectors so appointed were required to report in writing on the first day of every term of said court the condition of all such mines and whether

<sup>a</sup> Prior to 1863 the production of coal in what is now West Virginia was reported as of Virginia.

any employee had been injured, and the cause of such accident. By an act approved February 26, 1883, the inspection service was placed under the jurisdiction of a State mine inspector, and applied to all coal mines employing 15 or more miners. The inspector was required to render an annual report to the governor, showing number of employees, and number of persons killed or injured. The act of February 20, 1890, divided the State into two inspection districts and authorized the governor to appoint a mine inspector for each district, each inspector to render annual reports to the governor for years ending June 30. A chief mine inspector was authorized by the act of February 17, 1897, assisted by four district inspectors, who rendered monthly reports to the chief inspector. The department of mines was created by the act of February 25, 1905, and placed in charge of the chief mine inspector. The act of February 27, 1907, changed the title of chief mine inspector to that of chief of the department of mines, and the inspection law was extended to cover all mines employing five or more men. Various laws have increased the number of district inspectors until in 1914 there were twelve such inspectors.

#### ACCIDENTS.

Tables 138 and 139 show the production of coal and number of men employed, together with the fatalities in the coal mines in the State. The fatalities have been compiled from the reports of the State mine inspectors and are based on a calendar year, and do not, therefore, necessarily agree with the inspectors' figures published for fiscal years. During the period from 1885 to 1913, for which continuous complete records are available, there were 4,748 fatalities, representing 4.97 fatalities per 1,000 men employed. The amount of coal produced per fatality during this period was 160,635 tons or 6.23 fatalities per million tons of coal mined. During this period there have been 30 mine disasters, in each of which 5 or more men were killed.

FATALITIES IN **WEST VIRGINIA** COAL MINES, BY PRINCIPAL CAUSES, 1885 TO 1913 INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.)	2,452	51.61	2.57
Mine cars and locomotives	557	11.73	.58
Gas and dust explosions	1,036	21.82	1.09
Explosives	155	3.27	.16
Miscellaneous	202	4.25	.21
Shaft	67	1.41	.07
Surface	279	5.88	.29
Total, 29 years	4,748	100.00	4.97



## COAL-MINE ACCIDENTS IN WEST VIRGINIA IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1886 Jan. 31.....	Newburg.....	Newburg.....	Mine explosion.....	39
1894 Nov. 20.....	Blanche.....	Standard.....	Powder and coal-dust explosion.....	8
1900 Mar. 6.....	Red Ash.....	Red Ash.....	Mine explosion.....	46
1900 Nov. 2.....	Berryburg.....	Berryburg.....	Powder-smoke explosion.....	15
1901 May 15.....	Chatham.....	Farmington.....	Mine explosion.....	10
1902 Sept. 15.....	Algoma No. 7.....	Algoma.....	do.....	17
1902 Sept. 22.....	Stafford.....	Stafford.....	do.....	6
1905 Feb. 26.....	Grapevine.....	Wilcoe.....	Powder and mine explosion.....	6
1905 (Mar. 18.....)	Rush Run and Red Ash.....	Red Ash.....	Mine explosion.....	24
1905 (Mar. 19.....)	Cabin Creek.....	Keyford.....	Powder explosion.....	6
1905 Apr. 20.....	Tidewater.....	Vivian.....	Powder and mine explosion.....	7
1905 Dec. 4.....	Horton.....	Horton.....	Mine fire.....	7
1906 Jan. 4.....	Coaldale.....	Coaldale.....	Mine explosion.....	22
1906 Jan. 18.....	Detroit.....	Detroit.....	do.....	18
1906 Feb. 8.....	Parral.....	Parral.....	do.....	23
1906 Mar. 22.....	Century No. 1.....	Century.....	Powder and mine explosion.....	23
1907 Jan. 26.....	Lorentz.....	Penco.....	Powder explosion.....	12
1907 Jan. 29.....	Stuart.....	Stuart.....	Mine explosion.....	84
1907 Feb. 4.....	Thomas No. 25.....	Thomas.....	do.....	25
1907 May 1.....	Whipple.....	Scarboro.....	do.....	16
1907 Dec. 6.....	Monongah Nos. 6 and 8.....	Monongah.....	do.....	361
1908 Jan. 30.....	Backman.....	Hawk's Nest.....	do.....	9
1908 Dec. 29.....	Lick Branch.....	Switchback.....	do.....	50
1909 Jan. 12.....	do.....	do.....	do.....	67
1909 Mar. 31.....	Echo.....	Buery.....	Dynamite explosion.....	6
1910 Dec. 31.....	Lick Fork.....	Thacker.....	Mine cars.....	10
1911 Apr. 24.....	Ott No. 20.....	Elk Garden.....	Mine explosion.....	23
1911 Nov. 18.....	Bottom Creek.....	Vivian.....	do.....	18
1912 Mar. 26.....	Jed.....	Jed.....	do.....	81
1912 July 11.....	Panama.....	Moundsville.....	do.....	8
1914 Apr. 28.....	Eccles Nos. 5 and 6.....	Eccles.....	do.....	181
1914 June 30.....	Cindrella.....	Cindrella.....	Suffocated by fumes from fire in fan house.....	5
1915 Feb. 6.....	Carlisle.....	Carlisle.....	Mine explosion.....	21
1915 Mar. 2.....	Layland No. 3.....	Layland.....	do.....	112
1915 Nov. 30.....	Boomer No. 2.....	Boomer.....	do.....	23

Of the total number of fatalities during the 29-year period, 51.64 per cent were due to falls of roof and coal; 21.82 to gas and dust explosions; and 11.73 to mine cars and locomotives. Fatalities due to explosives were comparatively few, representing only 3.27 per cent of the total. The percentage of fatalities due to explosives in Oklahoma for a period of 21 years was 15.77; in Ohio, for a period of 30 years, 7.02; and in Illinois, for a period of 29 years, 13.47.

Since 1903, both the 9-hour and the 10-hour day have prevailed throughout the State, there being more than 50 per cent of the men employed on a 10-hour basis. For a true comparison with other States where an 8-hour or a 9-hour day prevails, the time element has been taken into consideration, and Tables 40 and 41 have been compiled on the basis of the actual number of men employed over a 10-year period, 1903 to 1913, inclusive, except 1909; also on the basis of 2,000-hour workers. The fatality rate during the 10-year period based on the actual number of employees is 5.53 per 1,000, and reduced to the equivalent of 2,000-hour workers becomes 5.18. The number of hours worked a year per man in West Virginia is 2,132, as compared with 1,495 for Ohio. The Ohio rate based on the



NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN WEST VIRGINIA.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, and 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
1903.....	45	1,685	110	10,311	212	22,260	7,298	41,554
1904.....	53	1,870	137	11,855	271	30,751	2,759	47,235
1905.....	49	3,532	161	14,387	251	25,731	4,739	48,389
1906.....	43	2,510	190	15,208	308	31,531	1,711	50,960
1907.....	35	1,879	156	13,386	322	32,005	11,759	59,029
1908.....	30	1,242	180	14,426	403	39,550	1,643	56,861
1909 <sup>b</sup> .....								55,433
1910.....	49	4,671	133	12,950	494	50,432	610	68,663
1911.....	49	4,242	126	11,477	527	49,996	1,085	66,800
1912.....	47	4,959	119	10,815	535	50,944	1,530	68,248
1913.....	29	1,864	369	35,123	365	37,094	705	74,786

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.

<sup>b</sup> Census year.

## NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN WEST VIRGINIA AND THE FATALITY RATE BASED ON THE NUMBER OF 2,000-HOUR WORKERS.

Year.	Days worked.	Total hours per day (all employees).	Total hours per year.	Number of 2,000-hour workers.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1903.....	210	394,561	\$3,857,810	41,429	147	3.55
1904.....	197	453,996	89,437,212	44,719	149	3.33
1905.....	209	457,700	95,659,300	47,830	212	4.43
1906.....	220	487,661	107,285,420	53,643	277	5.16
1907.....	230	561,387	129,119,010	64,560	736	11.40
1908.....	185	550,057	101,760,545	50,880	310	6.09
1909.....						
1910.....	228	663,728	151,329,984	75,665	329	4.35
1911.....	221	646,954	142,976,834	71,488	341	4.77
1912.....	266	660,217	175,617,722	87,809	381	4.34
1913.....	234	708,304	165,743,136	82,872	337	4.07

actual number of employees is 2.94, and reduced to the equivalent number of 2,000-hour workers becomes 3.94, so that the difference between the figures for the two States is not so great as would appear when the rates are based on the actual number of employees. Similar comparisons in these details may be made with other States by referring to Table 41. The tables of statistics for the State follow:

STATISTICS OF STRIKES AND LOCKOUTS IN AND ABOUT THE COAL MINES IN WEST VIRGINIA.<sup>a</sup>

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1899.....	3,468	76,829	22	1907.....	617	9,749	16
1900.....	1,883	44,318	24	1908.....	501	71,992	144
1901.....	1,438	45,161	31	1909.....	1,919	29,565	15
1902.....	18,129	1,362,054	75	1910.....	1,630	13,985	9
1903.....	1,524	63,212	41	1911.....	1,510	16,483	11
1904.....	3,682	167,343	45	1912.....	12,165	606,588	50
1905.....	462	12,111	26	1913.....	8,800	377,405	43
1906.....	4,101	123,724	30	1914.....	9,330	466,768	50

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.



1903.	29,357,241	1.17	41,554	147	3.54	5.01	199,573	210	706	3.36	27.9	338	430	788
1904.	32,406,752	.88	47,285	149	3.15	4.60	217,195	197	686	3.18	26.4	410	491	901
1905.	37,791,580	.86	48,380	212	4.38	5.61	178,262	209	781	3.74	33.1	473	628	1,105
1906.	43,290,350	.95	50,960	277	5.44	6.40	156,283	220	849	3.86	36.0	571	744	1,322
1907.	48,091,583	.99	50,020	736	12.17	15.30	65,342	230	815	3.54	36.7	617	853	1,533
1908.	41,897,843	.95	56,861	310	5.45	7.40	135,154	185	737	3.98	36.8	509	809	1,574
1909.	51,849,230	.86	55,433	336	6.06	6.48	154,313	( <sup>b</sup> )	935	( <sup>b</sup> )	40.8	700	1,036	1,844
1910.	61,671,019	.92	68,663	329	4.79	5.33	187,450	228	898	3.94	45.4	680	1,081	1,905
1911.	59,831,580	.90	66,800	341	5.10	5.70	175,459	221	896	4.05	46.9	667	1,011	2,044
1912.	66,786,687	.94	68,248	381	5.58	5.70	175,293	206	979	3.68	46.6	604	1,217	2,553
1913.	71,308,982	1.01	74,786	337	4.51	4.73	211,599	234	954	4.08	43.6	562	1,364	2,533
Total.	787,543,870			4,768										788
(Average 1885-1913)	26,299,767		32,955	163.72	4.97	6.23	160,635	220	798	3.63	38.9	517	1,407	2,607
1914.	71,707,626	1.00	78,963	556	7.04	7.75	128,971	201	908	4.52	40.4	517	1,407	2,607

<sup>a</sup> No report published for 1884.

<sup>b</sup> Not reported.

TABLE 133.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN WEST VIRGINIA, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE, DURING THE CALENDAR YEARS 1883 TO 1914, INCLUSIVE.

Year.	Killed underground.										Killed in shaft.						Killed on surface.						Grand total.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cages or skips.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and loco-motives.	Other causes.	Total.	
1883.....	11	6	2										19	13	14	15	16			17	18	19	20	21	22	1	20
1884 <sup>a</sup> .....																											23
1885.....	12	4	1	3									20									3				3	47
1886.....	4		1	39									44											1	2	3	
1887.....	9		1										11													11	
1888.....	18	5	2										25	1		1										1	28
1889.....	7	8	2										13													1	14
1890.....	18	3	1	5		3							25								2					1	29
1891.....	25	6	6			1							43								1					4	47
1892.....	23	12	3			5							45								1					2	45
1893.....	35	13	7										57	3							2					2	62
1894.....	41	11	11		8								76	1							1					2	79
1895.....	40	8	4			5							60								4					4	64
1896.....	42	5	8										61								1					4	65
1897.....	47	14	7	1		2							71	1		1					2					5	77
1898.....	51	15	12	3		4		3					80								1					3	90
1899.....	58	15	13			2							89								2					2	95
1900.....	70	12	9	47		19			1	1			141								7					6	150
1901.....	61	16	14	23	3	5		1			1		122	1							8					10	133
1902.....	79	20	13	2		7		3					130	5							6					16	147
1903.....	93	13	16	2		3			2				132	2		2					10					13	149
1904.....	99	7	25	7	38	10			2		8		137	7		2					12					24	177
1905.....	108	12	18	26	66	5		6		1			243	1		2					6					16	200
1906.....	132	17	37	25	46	20		4	1	1			277	1		2					10					31	227
1907.....	121	30	39	1	59	11		10	3	1			323	1		1					4					24	277
1908.....	142	30	52	4	67	14		11		4			361	2							2					31	310
1909.....	173	31	55	3		8		20	1	4			321	3		11					1					31	336
1910.....	164	28	55	18	23	3		22	2	4			361	2							3					12	336
1911.....	176	30	86	8	83	6		21		6			319	1		2					3					19	329
1912.....	170	30	86			5		17		5			524	2		1					2					18	341
1913.....	187	33	73	132		5		29	2	5			524	1		1					1					3	357
1914.....																										28	556

c No report published.



## WYOMING.

## AREA AND DISTRIBUTION OF COAL FIELDS.

The coal fields of Wyoming comprise an area of about 25,000 square miles. In addition to this area, in which the coal beds are fairly well known, there are a number of deep basins such as Bighorn Basin, Wind River Basin, and Green River Basin, aggregating 16,000 square miles, in which coal beds are doubtless present, but are at such a depth as possibly to be unavailable.

The most important region in point of quality of coal and quantity produced is the Green River Basin, including the belt of disturbed rocks in Lincoln and Uinta counties. This region comprises about 18,000 square miles underlain by coal-bearing rocks, but an area of only 8,000 square miles contains coal beds that are now accessible. This region includes the Kemmerer and Rock Springs districts, which produce practically all of the high-grade coal of the State. The production of this region in 1913 was about 4,500,000 tons.

The region of next importance is the Powder River region, which has an area of 74,000 square miles. Of this, an area of about 11,000 square miles is believed to be underlain by coal beds more than 3 feet thick. The coal in this field is subbituminous, and Sheridan is the chief center of production.

In the Bighorn, Wind River, and Hanna Basins and in the belt of disturbed rocks in Lincoln and Uinta counties the coal beds are considerably disturbed and in places dip at high angles, but in other fields the dips are low and regular, or the beds are practically flat.

## CHARACTER OF COAL BEDS.

The general structure of the Rock Springs district of the Green River field is that of a dome, the axis of which is about 90 miles long extending north and south. The coal beds on the west of this anticlinal axis dip  $5^{\circ}$  to  $30^{\circ}$ , whereas those on the east vary from  $5^{\circ}$  to  $10^{\circ}$ . There are many normal faults of less than 100 feet in displacement. There are four coal-bearing groups, containing 20 beds 2 to 12 feet thick, aggregating 90 feet at Rock Springs, Sweetwater County, which produced in 1913 about 35 per cent of the State's output.

In the Kemmerer district, Lincoln County, there are three principal coal beds known as the Upper, Main, and Lower Kemmerer beds. These range from 4 to 14 feet in thickness and are generally considered as the best coals in the State. They dip  $20^{\circ}$  to  $25^{\circ}$  to the west. This district has the distinction of containing the thickest coal bed that has been mined in the United States. It is 84 feet thick in the old prospect entry, but as the coal slacked badly the mine was abandoned.

In the Powder River field, immediately east of Sheridan, there are 5 coal beds as follows: Healy, 10 to 15 feet thick; Felix, 6 to 30 feet thick; Arvada, 5 to 10 feet thick; Roland, 3 to 7 feet thick; and Smith, 4 to 10 feet thick. South of Sheridan is a small area, known as the Buffalo district, containing the Healy bed, which is about 15 feet thick, and the Walters bed, which is 35 feet thick. These beds are also horizontal. Sheridan County in this field produced 15 per cent of the State's 1913 output.

In the Little Snake River field the coal beds are inclined from horizontal to about  $35^{\circ}$ . The coal is 3 to 12 feet thick, with shale and sandstone roof.

In the Bighorn Basin the beds dip  $3^{\circ}$  to  $56^{\circ}$ , varying from 5 to 10 feet in thickness. Little coal has been mined from this area.

### MINING METHODS.

The earliest statistics of coal production in Wyoming are for 1865, when 800 tons of coal was produced. In 1913 the production was 7,393,066 tons.

In most of the mines thus far developed in the Rock Springs district the roof and floor of the coal beds are firm and give little trouble. The majority of the mines are opened by slopes and a few by shafts. The room-and-pillar method of mining is used in coal beds varying from 4 to 8 feet in thickness. In the Rock Springs district a large percentage of the coal is mined by shooting off the solid. There is comparatively little gas in the mines.

In the northern part of the State, in Sheridan County, mines are opened by drifts and the coal is mined by room-and-pillar methods. The coal beds are thicker than in the Rock Springs district, varying from 10 to 19 feet, and in places are 25 to 30 feet thick.

Mining machines have been in use in Wyoming since about 1890. In 1913 there were 195 machines in use, producing 41 per cent of the coal; 36.7 per cent was mined by being shot off the solid; and 21.9 per cent by hand mining. A number of the mines are using electric coal-cutting machines, and haulage is by mules and electricity.

### REPORTABLE ACCIDENTS AND ORGANIZATION OF INSPECTION SERVICE.

The inspection of coal mines was placed under the jurisdiction of a Territorial mine inspector by an act approved February 25, 1886, covering all coal mines in which 10 or more men were employed. Operators were required to render to the inspector immediate reports of all fatal and serious accidents. All fatal accidents were to be reported to the county coroner also, and upon such notice an investigation was conducted to determine the cause of the accident. The inspector rendered quarterly reports showing number of accidents

and deaths from injuries, number employed at the mines, etc., and published his report in at least one paper in each county in which there were any coal mines. The act of February 17, 1903, divided the State into two inspection districts and authorized the governor to appoint a mine inspector for each district, the inspector to render quarterly reports of accidents. By the act of February 27, 1903, the inspectors were required, within one week after the examination of each mine, to send a written report of such examination to the governor and also to file with the governor an annual report not later than December 1 of each year. There are no regular deputy or assistant inspectors, but the district inspectors are authorized to appoint temporary deputies to investigate accidents when it is impossible for the district inspectors to be present in person.

Prior to the enactment of the workmen's compensation law, mine operators reported to the inspectors only those injuries resulting in disability to an employee for at least 14 days, and these were published in the inspectors' annual reports. Under the compensation law, which became effective April 1, 1915, all accidents at mines are required to be reported.

#### ACCIDENTS.

Tables 140 and 141 show the production of coal and number of employees since 1889 to the end of 1913. The fatality records are not so complete, continuous records being available only from 1908 to the end of 1913. During this period of 6 years there were 241 fatalities in and about the coal mines, representing 5.21 fatalities per 1,000 men employed. The production of coal per fatality was 169,801 tons, or 5.89 fatalities per million tons of coal mined. Of the total number of men killed during the 6-year period, 47.30 per cent was due to falls of roof and coal; 27.80 per cent to gas and dust explosions; and 9.13 per cent to mine cars and locomotives.

FATALITIES IN WYOMING COAL MINES, BY PRINCIPAL CAUSES, DURING THE YEARS 1908 TO 1913, INCLUSIVE.

Cause of accident.	Number killed.		
	Total.	Per cent.	Per 1,000 employed.
Underground:			
Fall of roof and pillar (coal, rock, etc.)	114	47.30	2.46
Mine cars and locomotives	22	9.13	.48
Gas and dust explosions	67	27.80	1.45
Explosives	13	5.40	.28
Miscellaneous	17	7.05	.37
Shaft	1	.41	.02
Surface	7	2.91	.15
Total, 6 years	241	100.00	5.21



## COAL-MINE ACCIDENTS IN WYOMING IN WHICH 5 OR MORE MEN WERE KILLED.

Date.	Name of mine.	Location of mine.	Nature of accident.	Number killed.
1881 Mar. 4.....	Almy.....	Almy.....	Mine explosion.....	38
1886 Jan. 13.....	Almy No. 4.....	do.....	do.....	13
1895 Mar. 20.....	Red Canyon.....	Red Canyon.....	do.....	60
1901 Feb. 25.....	Diamondville No. 1.....	Diamondville.....	Mine fire.....	28
1901 Oct. 26.....	Diamondville.....	do.....	Mine explosion.....	22
1903 June 30.....	Hanna No. 1.....	Hanna.....	Mine explosion and fire.....	169
1905 Dec. 1.....	Diamondville No. 1.....	Diamondville.....	Mine explosion.....	18
1908 Mar. 28.....	Hanna No. 1.....	Hanna.....	do.....	59
1912 Jan. 20.....	Kemmerer No. 4.....	Kemmerer.....	do.....	6
1914 Apr. 29.....	Union Pacific No. 2.....	Cumberland.....	Mine cars.....	5

Since 1881 there have been 11 coal-mine disasters, in each of which five or more men were killed at one time, representing 428 fatalities. A list is given in the accompanying table.

Since 1907 the mines in Wyoming have been operated on an 8-hour basis, and for comparison with States having 9-hour and 10-hour days, the time element has been taken into consideration. The number of hours worked per annum per man in Wyoming for the 10-year period 1903 to 1913, except 1909, was 2,137. The fatality rate during the 5 years 1908, 1910, 1911, 1912, and 1913, for which complete records are available, is 5.38, based on the actual number of employees, whereas if based on the equivalent number of 2,000-hour workers it becomes 5.71. By referring to Tables 40 and 41, comparisons with other States may be readily made. The tables of statistics for the State follow:

NUMBER OF HOURS TO THE WORKING DAY, BY YEARS, IN AND ABOUT THE COAL MINES IN WYOMING.<sup>a</sup>

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Number of men.	Number of mines.	Number of men.	Number of mines.	Number of men.		
1902.....	2	289	2	583	20	4,024	97	4,993
1904.....	5	19	1	491	17	5,087	63	5,660
1905.....	2	8	2	456	26	5,492	21	5,977
1906.....	2	8	2	25	29	5,500	401	5,934
1907.....	37	6,382	6	197			66	6,645
1908.....	51	6,802			2	17	96	6,915
1909 <sup>b</sup> .....								7,123
1910.....	41	6,175					1,596	7,771
1911.....	60	6,571	2	5			1,542	8,118
1912.....	60	7,807	1	3			226	8,036
1913.....	56	8,321	2	6	1	4		8,331

<sup>a</sup> Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.<sup>b</sup> Census year.



NUMBER OF HOURS WORKED IN AND ABOUT THE COAL MINES IN WYOMING AND THE FATALITY RATE BASED ON THE NUMBER OF 1,000-HOUR WORKERS.

Year.	Days worked.	Total hours worked (all employees).	Total hours per person.	Number of persons per hour worked.	Fatalities.	
					Total.	Per 1,000 2,000-hour workers.
1892	252	48,677	12,265.34	6.133		
1893	262	46,988	14,674.096	7.337		
1894	286	39,277	13,989.372	6.995		
1895	281	38,890	16,550.338	8.275		
1897	275	37,415	14,691.325	7.346		
1898	217	55,450	12,032.650	6.017	81	13.46
1899						
1900	248	60,744	15,813.472	7.607	56	4.55
1901	230	65,194	15,292.030	7.647	52	4.18
1902	298	67,377	15,355.046	7.678	36	4.69
1903	276	66,662	15,465.584	7.753	26	3.36

STATISTICS OF STRIKES AND LOCK-OUTS IN AND ABOUT THE COAL MINES IN WYOMING.

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
1893				1907	1,785	22,060	12
1894				1898	3,638	99,576	21
1895	160	1,120	7	1899			
1897				1900	1,196	12,792	11
1898	413	4,130	10	1901			
1899				1902	390	3,425	10
1900	102	122	1	1903			
1901	231	5,759	25	1904	248	2,727	11

a Compiled from annual volumes of Mineral Resources, U. S. Geol. Survey.





TABLE 142.—NUMBER OF MEN KILLED IN AND ABOUT THE COAL MINES IN THE UNITED STATES DURING THE CALENDAR YEAR 1915, WITH THE FATALITIES CLASSIFIED ACCORDING TO CAUSE.

State.	Killed underground.										Killed in shaft.						Killed on the surface.						Total by States.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillars of coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions.	Explosives, <sup>a</sup> mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or skips.	Cares or skips.	(Other causes.	Total.	Mile-cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions (steam pipes.	Railway cars and locomotives.		Other causes.	Total.
Alabama.....	21	2	17	5	5	7	1	1	1	1	1	60	1	1	1	1	1	1	1	1	1	1	1	63	128
Alaska and California.....	5	1	1	1	1	1	1	1	1	1	1	6	1	1	1	1	1	1	1	1	1	1	1	8	0
Arkansas.....	40	1	2	1	1	1	1	1	1	1	1	59	1	1	1	1	1	1	1	1	1	1	1	60	75
Colorado.....	45	12	20	20	2	11	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1	1	136	137
Georgia and North Carolina.....	17	2	1	1	1	1	1	1	1	1	1	34	1	1	1	1	1	1	1	1	1	1	1	46	47
Idaho and Nevada.....	23	10	5	1	1	1	1	1	1	1	1	22	1	1	1	1	1	1	1	1	1	1	1	24	37
Illinois.....	10	2	1	1	1	1	1	1	1	1	1	59	1	1	1	1	1	1	1	1	1	1	1	61	61
Indiana.....	35	3	11	1	1	1	1	1	1	1	1	9	1	1	1	1	1	1	1	1	1	1	1	16	12
Iowa.....	1	1	1	1	1	1	1	1	1	1	1	10	1	1	1	1	1	1	1	1	1	1	1	17	12
Kansas.....	1	1	1	1	1	1	1	1	1	1	1	18	1	1	1	1	1	1	1	1	1	1	1	19	18
Kentucky.....	1	1	1	1	1	1	1	1	1	1	1	11	1	1	1	1	1	1	1	1	1	1	1	19	18
Louisiana.....	1	1	1	1	1	1	1	1	1	1	1	19	1	1	1	1	1	1	1	1	1	1	1	19	18
Maryland.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Michigan.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Minnesota.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Missouri.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Montana.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Nebraska.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Nevada.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
New Mexico.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
North Dakota.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Oklahoma.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Oregon.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	18
Pennsylvania (anthracite).....	104	67	80	34	70	11	1	1	1	1	1	516	10	1	1	1	1	1	1	1	1	1	1	59	505
Pennsylvania (bituminous).....	201	41	77	30	3	1	1	1	1	1	1	400	8	10	1	1	1	1	1	1	1	1	1	438	492
Tennessee.....	15	1	1	1	1	1	1	1	1	1	1	25	1	1	1	1	1	1	1	1	1	1	1	25	20
Texas.....	1	1	1	1	1	1	1	1	1	1	1	10	1	1	1	1	1	1	1	1	1	1	1	11	22
Utah.....	1	1	1	1	1	1	1	1	1	1	1	16	1	1	1	1	1	1	1	1	1	1	1	11	22
Virginia.....	30	1	1	1	1	1	1	1	1	1	1	46	1	1	1	1	1	1	1	1	1	1	1	48	27
Washington.....	5	3	1	1	1	1	1	1	1	1	1	42	1	1	1	1	1	1	1	1	1	1	1	45	77
West Virginia.....	184	12	72	53	112	6	1	1	1	1	1	400	2	2	1	1	1	1	1	1	1	1	1	494	550
Wyoming.....	15	4	1	1	1	1	1	1	1	1	1	23	1	1	1	1	1	1	1	1	1	1	1	26	51
Total, 1915.....	917	160	347	153	151	155	16	89	3	12	1	62	2,666	31	2	7	40	62	10	26	6	14	43	180	2,266
Total, 1914.....	985	146	380	332	17	146	14	80	7	20	7	57	2,200	70	5	12	48	65	11	26	5	15	45	166	2,451

<sup>a</sup> Includes premature blasts, explosion of misfires, suffocation by gases from explosives, etc.



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# INDEX.

A.	Page
Albion mine, Alabama, explosion.....	72, 141
Accidents not attributable to mining, omission of.....	3
personal element in.....	4
<i>See also</i> Fatalities and States listed.	
Acton No. 2 mine, Alabama, explosion.....	73, 141
Adamson No. 1 mine, Oklahoma, accident..	73, 271
Agnes and Rachel mine, Marianna, Pa., explosion.....	72, 298
Air compressors, number in Pennsylvania coal mine.....	85
Alabama, coal mined by hand, percentage...	144
mined by machine, percentage.....	144
shot off solid, amount.....	144
value per ton at mine.....	144
coal fields in, area.....	134, 136
coal mines, accidents.....	140, 141
days worked annually at.....	144
disasters, list of.....	141
fatalities at.....	144, 145
by causes.....	141
chart showing.....	26
fatality rates.....	144
chart showing.....	26
on 2,000-hour basis.....	142
hours worked daily.....	142
lockouts and strikes.....	143
men employed.....	12, 144
mining machines, number.....	144
mining methods.....	139
coal production.....	134, 141
per death.....	144
per man.....	144
mine-inspection service.....	140
mines, accidents reportable.....	140
Alaska, coal fields in, area.....	135
Alderson No. 1 mine, Oklahoma, explosion.	70, 271
Algoma No. 7 mine, West Virginia, explosion.....	71, 342
Almy mine, Wyoming, explosion.....	69, 350
Almy No. 4 mine, Wyoming, explosion.....	69, 350
Amsterdam mine, Ohio, explosion.....	72, 261
Animal haulage, Illinois.....	86
Pennsylvania.....	84, 85
Animals, fatalities from.....	14
Anthracite coal-fields, in United States, areas.....	134, 281
Anthracite coal mines, Pennsylvania, fatality rates, by occupation.....	93, 94
Appalachian coal fields, area.....	134
Arizona, coal field in, area.....	135
Arkansas, coal mined by hand, percentage...	150
mined by machine, percentage.....	150
shot off solid, amount.....	150
value per ton at mine.....	150
coal fields in, area.....	134, 146

	Page.
Arkansas coal mines, accidents.....	11, 148
accidents reportable.....	147
days worked annually.....	150
disasters, list of.....	148
fatalities at.....	150
by causes.....	152
chart showing.....	25
fatality rates.....	150
chart showing.....	26
on 2,000-hour basis.....	149
hours worked daily.....	148
inspection service.....	147
lockouts and strikes.....	149
men employed.....	12, 150
mining machines, number.....	150
mining methods.....	146
coal production.....	150
per death.....	150
per man.....	150
Ashland mine tunnel, Pennsylvania, accident.....	69, 287
Athens No. 2 mine, Illinois, accident.....	71, 172
Atlantic Coast coal fields, area.....	134
Atlas mine, Rich Hill, Mo., explosion.....	73, 230
Auchincloss mine, Nanticoke, Pa., accident.....	71, 72, 287, 288
Audenreid mine, Pennsylvania, explosion..	69, 287
Avondale mine, Plymouth, Pa., fire.....	69, 287
B.	
Backman mine, Hawks Nest, W. Va., explosion.....	71, 342
Baker No. 5 mine, Clay, Ky., explosion.....	72, 208
Banner mine, Littleton, Ala., explosion....	72, 141
Barthell No. 1 mine, Stearns, Ky., explosion	72, 208
Bast mine, Big Mine Run, Pa., accident....	69, 298
Belle Ellen mine, Alabama, fire.....	70, 141
Bernal mine, Carthage, N. Mex., explosion.....	71, 246
Berryburg mine, W. Va., explosion.....	70, 342
Berwind mine, Dubois, Pa., explosion.....	70, 298
Bevier coal field, Missouri.....	228
Big Muddy mine, Herrin, Ill., explosion....	71, 172
Bituminous coal, production by machines..	110
Bituminous coal fields, area of.....	134
<i>See also</i> States listed.	
Bituminous coal mines, days worked annually.....	105
fatalities at.....	104
figures showing.....	114, 115, 118, 119
by causes.....	105
figure showing.....	104
percentage.....	106
figures showing.....	104, 114
per 1,000 employed.....	106
figures showing.....	93, 115
<i>See also</i> States listed.	

	Page.		Page.
Bituminous coal mines, machine mining....	107	Carlisle mine, West Virginia, explosion.....	73, 342
percentage under inspection.....	105	Catsburg mine, Monongahela, Pa., explosion.....	70, 298
production per man.....	105	Central mine, Central City, Ky., explosion..	72, 208
figure showing.....	119	Central Slope 77 mine, Carbon, Okla., explosion.....	71, 271
Black Diamond mine, Nortonville, Cal., explosion.....	69, 153	Century No. 1 mine, West Virginia, explosion.....	71, 342
Black Heath mine, Richmond, Va., explosion.....	69, 325	Chain-breast machines in United States, number of.....	109
Black powder. <i>See</i> Explosives.		<i>See also</i> States listed.	
Blanche mine, Standard, W. Va., explosion.	70, 342	Chance, H. M., on mining methods in anthracite coal fields.....	283
Blocton No. 2 mine, Alabama, explosion....	70, 141	Chatham mine, Farmington, W. Va., explosion.....	70, 342
Blossburg No. 3 mine, New Mexico, explosion.....	71, 246	Cherry mine, Illinois, fire.....	72, 172
Blown-out shots, fatalities from.....	78	Chesterfield mine, Richmond, Va., explosion.....	69, 325
Blue Canyon mine, Lake Whatcom, Wash., explosion.....	70, 333	Chicago and Iowa mine, Albia, Iowa, explosion.....	70, 190
Boiler explosions, fatalities from.....	14	Cincinnati mine, Finleyville, Pa., explosion.....	72, 298
Bonanza No. 20 mine, Arkansas, explosion.	71, 148	Cinderella mine, West Virginia, accident...	73, 342
Bond and Bruce mine, Tacoma, Va., explosion.....	71, 325	Clear Spring mine, West Pittston, Pa., accident.....	71, 287
Boomer No. 2 mine, West Virginia, explosion.....	73, 342	Clyde mine, Fredericktown, Pa., fire.....	71, 298
Bottom Creek mine, Vivian, W. Va., explosion.....	72, 342	Coal, available supply of.....	134
Bowen mine, Colorado, explosion.....	70, 159	mined by hand. <i>See</i> States listed.	
Braznell mine, Bentleyville, Pa., explosion.	71, 298	mined by machines.....	107, 108
Breese-Trenton mine, Illinois, accident....	71, 172	<i>See also</i> States listed.	
Brookfield mine, Ohio, accident.....	69, 261	shot off solid. <i>See</i> States listed.	
Browder mine, Kentucky, explosion.....	72, 208	value per ton at mine.....	10
Buck Mountain mine, Mahanoy, Pa., explosion.....	70, 287	<i>See also</i> States listed.	
Buck Ridge mine, Shamokin, Pa., fire.....	69, 237	Coal cutting machines, types of.....	109
Burnett No. 5 mine, Washington, explosion.....	71, 333	<i>See also</i> Machines named.	
Buttonwood mine, Plymouth, Pa., explosion.....	70, 287	Coal fields in the United States, area by States.....	134, 135
C.		<i>See also</i> States listed.	
Cabin Creek mine, Kayford, W. Va., explosion.....	71, 342	Coal-mine disasters.....	65
Cages or skips, fatalities from.....	14, 90	by causes.....	66
Cahaba coal field, Alabama.....	137	by number of men killed.....	66
Calendar year, statistics by.....	27-50, 133	list of.....	69
advantage of.....	4, 5	<i>See also</i> States listed.	
<i>See also</i> States listed		Coal-mine fatalities. <i>See</i> Fatalities and States listed.	
California, coal mined by hand, percentage..	154	Coal mines, changing conditions in.....	26
mined by machine, percentage.....	154	men employed.....	5, 12
shot off solid, amount.....	154	nonfatal injuries in.....	96
value per ton at mine.....	154	<i>See also</i> Bituminous coal mines and States listed.	
coal fields in, area.....	135, 153	Coal-mining machines. <i>See</i> Mining machines and States listed.	
coal mines, accidents.....	153	Coal production. <i>See</i> Production.	
days worked annually.....	154	Coaldale mine, West Virginia, explosion....	71, 342
disasters, list of.....	153	Coil mine, Madisonville, Ky., explosion....	72, 208
fatalities at.....	154	Cokedale mine, Trinidad, Colo., explosion..	72, 159
by causes.....	155	Coke-oven accidents, omission of.....	5
men employed.....	12, 154	Coke-oven employees, omission of.....	5
mining machines, number.....	154	Colorado, coal mined by hand, percentage..	162
coal production.....	154	mined by machine, percentage.....	162
per man.....	154	shot off solid, amount.....	162
California State Mining Bureau on production of coal.....	153	value per ton at mine.....	162
Cameron mine, Shamokin, Pa., explosion....	72, 288	coal beds, character.....	156
Carbon Hill mine, Virginia, explosion.....	72, 325	coal fields in, area.....	134, 135, 156
Carbon Hill No. 7 mine, Carbonado, Wash., explosion.....	70, 333	coal mines, accidents.....	158
Cardiff mine, Illinois, explosion.....	71, 172	reportable.....	157, 158

[illegible]







	Page.		Page.
<b>Indiana, coal fields in, area</b> .....	134, 178	<b>Kansas, coal beds, character</b> .....	196
coal-mines, accidents.....	181	coal fields in, area.....	135, 196
accidents reportable.....	179	coal mines, accidents.....	198
days worked annually.....	184	accidents reportable.....	197
disasters.....	179	days worked annually.....	200
fatalities.....	184	disasters.....	198
by causes.....	186	fatalities.....	200
chart showing.....	26	by causes.....	202
fatality rates.....	184	chart showing.....	26
chart showing.....	26	fatality rates.....	200
on 2,000-hour basis.....	182	chart showing.....	26
hours worked daily.....	182	on 2,000-hour basis.....	199
inspection service.....	179	hours worked daily.....	199
lockouts and strikes.....	183	inspection service.....	197
men employed.....	12, 184	lockouts and strikes.....	199
mining machines, number.....	108, 184	men employed.....	12, 200
mining methods.....	179	mining machines, number.....	108, 200
coal production.....	184	mining methods.....	196
per death.....	184	coal production.....	200
per man.....	184	per death.....	200
<b>Injuries, nonfatal, coal mines</b> .....	96	per man.....	200
metal mines.....	96	<b>Kansas &amp; Texas No. 44 mine, Huntington,</b>	
parts of body injured.....	97, 98	Ark., explosion.....	70, 148
figure showing.....	98	<b>Kaska William mine, Middleport, Pa., ac-</b>	
<b>Inspection service. See Mine inspection</b>		cident.....	69, 70, 287
service and States listed.		<b>Keith &amp; Perry No. 6 mine, Rich Hill, Mo.,</b>	
<b>Iowa, coal mined by hand, percentage</b> .....	192	explosion.....	69, 230
mined by machine, percentage.....	192	<b>Kemmerer No. 4 mine, Wyoming, explosion</b> .....	72, 350
shot off solid, amount.....	192	<b>Kentucky, coal mined by hand, percentage</b> .....	210
value per ton at mine.....	192	mined by machine, percentage.....	210
coal beds, character.....	188	shot off solid, amount.....	210
coal fields in, area.....	135, 188	value per ton at mine.....	210
coal mines, accidents.....	190	coal beds, character.....	204
accidents reportable.....	189	coal fields in, area.....	134, 204
days worked annually.....	192	coal mines, accidents.....	207
disasters.....	190	accidents reportable.....	206
fatalities.....	192	days worked annually.....	210
by causes.....	194	disasters, list of.....	208
chart showing.....	26	fatalities.....	210
fatality rates.....	192	by causes.....	212
chart showing.....	26	chart showing.....	26
on 2,000-hour basis.....	191	fatality rates.....	210
hours worked daily.....	190	chart showing.....	26
inspection service.....	189	on 2,000-hour basis.....	209
lockouts and strikes.....	191	hours worked daily.....	208
men employed.....	12, 192	inspection service.....	206
mining machines, number.....	108, 192	lockouts and strikes.....	209
mining methods.....	188	men employed.....	12, 210
coal production.....	192	mining machines, number.....	108, 210
per death.....	192	mining methods.....	205
per man.....	192	coal production.....	210
<b>Iowa and Chicago mine, Albia, Iowa, explo-</b>		per death.....	210
sion.....	70, 190	per man.....	210
<b>Issaquah No. 4 mine, Washington, accident</b> .....	70, 333	<b>Kettle Creek mine, Clinton County, Pa., ex-</b>	
J.....		plosion.....	69, 298
<b>Jed mine, West Virginia, explosion</b> .....	72, 342	<b>Kohinoor mine, Shenandoah, Pa., explosion</b> .....	69, 287
<b>Jermyn No. 1 mine, Rendham, Pa., fire</b> .....	70, 287	<b>Krebs No. 11 mine, Oklahoma, explosion</b> .....	70, 271
<b>Jersey No. 8 mine, Ashley, Pa., explosion</b> .....	69, 287	L.....	
<b>Johnson No. 1 mine, Priceburg, Pa., explosion</b> .....	71, 288	<b>Labor at coal mines</b> .....	12
<b>Johnston City mine, Illinois, explosion</b> .....	71, 172	See also States listed.	
K.....		<b>Laborers in mines, fatality rates of</b> .....	93, 94
<b>Kansas, coal mined by hand, percentage</b> .....	200	figure showing.....	93
mined by machine, percentage.....	200	<b>Lackawanna No. 4 mine, Wehrum, Pa., ex-</b>	
shot off solid, amount.....	200	plosion.....	72, 208
value per ton at mine.....	200	<b>Lance mine, Plymouth, Pa., explosion</b> .....	70, 71, 287
14355°—Bull. 115—16—24		<b>Laurel mine, Pocahontas, Va., explosion</b> .....	69, 325

	Page.		Page.
Lawson mine, Black Diamond, Wash., explosion.....	71, 72, 333	Maryland coal mines, fatality rates.....	218
Layland No. 3 mine, West Virginia, explosion.....	73, 342	chart showing.....	26
Lehigh No. 4 mine, Lansford, Pa., explosion.....	73, 288	on 2,000-hour basis.....	216
Leiter mine, Zeigler, Ill., explosion.....	71, 172	hours worked daily.....	216
Lemont and Superba mine, Evans Station, Pa., accident.....	72, 298	inspection service.....	215
Leyden mine, Colorado, fire.....	72, 159	lockouts and strikes.....	217
Lick Branch mine, Switchback, W. Va., explosion.....	72, 342	men employed.....	12, 218
Lick Fork mine, Thacker, W. Va., accident.....	72, 342	mining machines, number.....	108, 218
Little Cahaba mine, Piper, Ala., explosion.....	71, 141	mining methods.....	214
Lockouts and strikes. <i>See</i> States listed.		coal production.....	218
Locomotives. <i>See</i> Compressed-air locomotives; Electric locomotives; Gasoline locomotives; Mine cars and locomotives.		per death.....	218
Locust Gap mine, Pennsylvania, fire.....	71, 287	per man.....	218
Long-wall machines in use, number of.....	109	Maryland Geological Survey, on coal beds of Allegany County, Md.....	213
<i>See also</i> States listed.		Men employed in anthracite mines.....	290
Lorentz mine, Penco, W. Va., explosion.....	71, 342	bituminous coal mines.....	105
Lost Creek No. 2 mine, Oskaloosa, Iowa, explosion.....	70, 190	figure showing.....	112, 114
Luke Fidler mine, Shamokin, Pa., explosion.....	71, 287	coal mines, by States.....	5, 12
fire.....	70, 287	figure showing.....	21
Lykens Valley mine, Shamokin, Pa., explosion.....	69, 287	relation to percentage of machine-mined coal.....	111, 120, 123, 126, 129
Lytle mine, Minersville, Pa., accident.....	70, 71, 287	<i>See also</i> States listed.	
		Metal mines, nonfatal injuries in.....	96
M.		Michigan, coal mined by hand, percentage.....	226
McAlester No. 5 mine, Alderson, Okla., accident.....	70, 271	mined by machine, percentage.....	226
Machine feed wire, contact with, fatalities from.....	88	shot off solid, amount.....	226
Machine loaders, fatality rates of.....	95	value per ton at mine.....	226
figure showing.....	93	coal beds, character.....	222
Machine mining.....	107	coal field, area.....	134, 222
<i>See also</i> Mining machines.		coal mines, accidents.....	223
Machine runners, fatality rates of.....	95	accidents reportable.....	223
figure showing.....	93	days worked annually.....	226
Machine scrapers, fatality rates of.....	95	fatalities at.....	226
figure showing.....	93	by causes.....	227
Maitland mine, Walsenburg, Colo., explosion.....	71, 159	chart showing.....	25
Mammoth mine, Mount Pleasant, Pa., explosion.....	69, 298	fatality rates.....	226
Maple Hill mine, Mahanoy City, Pa., explosion.....	71, 287	chart showing.....	26
Mariana mine, Pennsylvania, explosion.....	72, 298	on 2,000-hour basis.....	224
Marvine mine, Scranton, Pa., accident.....	69, 72, 287, 288	hours worked daily.....	224
Maryd mine, Pennsylvania, accident.....	73, 288	inspection service.....	223
Maryland, coal mined by hand, percentage.....	218	lockouts and strikes.....	225
mined by machine, percentage.....	218	men employed.....	12, 226
shot off solid, amount.....	218	mining machines, number.....	108, 226
value per ton at mine.....	218	mining methods.....	222
coal beds, character.....	213	quantity of explosives used.....	81
coal fields in, area.....	134, 213	coal production.....	226
coal mines, accidents.....	215	per death.....	226
accidents reportable.....	215	per man.....	226
days worked annually.....	218	Midlothian mine, Coalfield, Va., explosion.....	69, 325
disasters.....	215	Midvale mine, Wilkes-Barre, Pa., fire.....	70, 287
fatalities at.....	218	Milby & Dow mine, Dow, Okla., fire.....	70, 271
by causes.....	220	Mill Creek mine, Pennsylvania, explosion.....	69, 298
chart showing.....	26	Mine cars and locomotives, fatalities from.....	16, 23, 84
		by States.....	84
		fatality rate per 1,000 employed.....	16, 84
		<i>See also</i> States listed.	
		Mine disasters. <i>See</i> coal-mine disasters and States listed.	
		Mine fires from spontaneous combustion.....	76
		list of.....	75
		Mine foremen and assistants, fatality rates of.....	93, 94, 95
		figure showing.....	93
		Mine inspection service, coal-mining industry covered by, percentage.....	20
		employees under, percentage.....	10
		fatalities under.....	10, 105

	Page.
Mine inspection service, growth of.....	25
production of coal under.....	10, 105
<i>See also</i> States listed.	
Mineral No. 16 mine, Kansas, explosion.....	72, 198
Miners, fatality rates of.....	93, 94, 95
figure showing.....	93
Mining industry, accidents not attributable to.....	5
Mining machines, accidents.....	88
by principal causes.....	88, 110, 121, 124, 127, 130
coal mined by.....	107, 108
fatality rates.....	117, 120, 123, 126, 129
fatality rates affected by.....	111
number, by States.....	108
types of, number.....	109
<i>See also</i> machines named and States listed.	
Mining methods. <i>See</i> States listed.	
Missouri, coal mined by hand, percentage....	232
mined by machine, percentage.....	232
shot off solid, amount.....	232
value per ton at mine.....	232
coal beds, character.....	228
coal fields in, area.....	135, 228
coal mines, accidents.....	230
accidents reportable.....	229
days worked annually.....	232
disasters.....	230
fatalities.....	232
by causes.....	234
chart showing.....	26
fatality rates.....	232
chart showing.....	26
on 2,000-hour basis.....	231
hours worked daily.....	231
inspection service.....	229
lockouts and strikes.....	231
men employed.....	12, 232
mining machines, number.....	108, 232
mining methods.....	228
coal production.....	232
per death.....	232
per man.....	232
Monongah mine, West Virginia, explosion....	71, 342
Montana, coal mined by hand, percentage....	240
mined by machine, percentage.....	240
shot off solid, amount.....	240
value per ton at mine.....	240
coal beds, character.....	235
coal fields in, area.....	135, 235
coal mines, accidents.....	237
accidents reportable.....	236
days worked annually.....	240
disasters.....	237
fatalities at.....	240
by causes.....	242
chart showing.....	26
fatality rates.....	240
chart showing.....	26
on 2,000-hour basis.....	238
hours worked daily.....	238
inspection service.....	236
lockouts and strikes.....	239
men employed.....	12, 240
mining machines, number.....	108, 240
mining methods.....	236

Montana, coal production.....	240
per death.....	240
per man.....	240
Moody mine, South Carrollton, Ky., explosion.....	72, 208
Morgan mine, Black Diamond, Wash., explosion.....	71, 333
Mount Lookout mine, Wyoming, Pa., explosion.....	72, 288
Mulga mine, Alabama, explosion.....	72, 73, 141

## N.

Nanticoke No. 1 mine, Pennsylvania, accident.....	69, 287
Naomi mine, Fayette City, Pa., explosion..	71, 298
Neilson mine, Shamokin, Pa., fire.....	70, 287
Nelson mine, Dayton, Tenn., explosion.....	70, 306
Newburg mine, West Virginia, explosion....	69, 342
Newland-Spencer mine, Mulberry, Kans., accident.....	73, 198
New Mexico, coal mined by hand, percentage.....	248
mined by machine, percentage.....	248
shot off solid, amount.....	248
value per ton at mine.....	248
coal beds, character.....	243
coal fields, area.....	134, 135, 243
coal mines, accidents.....	245
accidents reportable.....	245
days worked annually.....	248
disasters.....	246
fatalities.....	248
by causes.....	250
chart showing.....	26
fatality rates.....	248
chart showing.....	26
on 2,000-hour basis.....	247
hours worked daily.....	247
inspection service.....	245
lockouts and strikes.....	247
men employed.....	12, 248
mining machines, number.....	108, 248
mining methods.....	244
coal production.....	248
per death.....	248
per man.....	248
North mine, Royaltown, Ill., explosion.....	73, 172
North Carolina, coal, value per ton at mine..	252
coal beds, character of.....	251
coal fields in, area.....	134, 251
coal mines, accidents reportable.....	251
days worked annually.....	252
disasters.....	251
inspection service.....	251
men employed.....	12, 252
coal production.....	252
per man.....	252
North Dakota, coal mined by hand, percentage.....	256
mined by machine, percentage.....	256
shot off solid, amount.....	256
value per ton at mine.....	256
coal fields of, area.....	135, 253
coal mines, accidents.....	254
accidents reportable.....	253
days worked annually.....	256



	Page.		Page.
North Dakota coal mines, fatalities at.....	256	Oklahoma, coal field in, area.....	135, 268
by causes.....	257	coal mines, accidents.....	270
chart showing.....	26	accidents reportable.....	270
fatality rates.....	256	days worked annually.....	274
chart showing.....	26	disasters.....	271
on 2,000-hour basis.....	255	fatalities.....	274
hours worked daily.....	254	by causes.....	276
inspection service.....	253	chart showing.....	26
lockouts and strikes.....	255	fatality rates.....	274
men employed.....	12, 256	chart showing.....	26
mining machines, number.....	108, 256	on 2,000-hour basis.....	272
mining methods.....	253	hours worked daily.....	272
coal production.....	256	inspection service.....	270
per death.....	256	lockouts and strikes.....	273
per man.....	256	men employed.....	12, 274
Northern Appalachian coal fields, permissible explosives used.....	82	mining machines, number.....	108, 274
Northwestern No. 1 mine, Ravensdale, Wash., explosion.....	73, 333	mining methods.....	269
Northwestern No. 4 mine, Roslyn, Wash., explosion.....	72, 333	coal production.....	274
Norwood, C. J., on mining methods in Kentucky.....	205	per death.....	274
Nottingham mine, Plymouth, Pa., explosion.....	69, 72, 287, 288	per man.....	274
O.		Old Dominion No. 1 mine, Carbon Hill, Va., explosion.....	72, 325
Objects falling down shaft or slopes, number killed by.....	14, 90	Oregon, coal, value per ton at mine.....	279
Occupation, fatalities classified by.....	92	coal field in, area.....	135, 277
figure showing.....	93	coal mines, accidents.....	277
O'Gara No. 9 mine, Harrisburg, Ill., explosion.....	72, 172	accidents reportable.....	277
Ohio, coal mined by hand, percentage.....	264	days worked annually.....	279
mined by machine, percentage.....	264	fatalities.....	279
shot off solid, amount.....	264	by causes.....	280
value per ton at mines.....	264	fatality rates.....	279
coal beds, character.....	258	inspection service.....	277
coal field in, area.....	134, 258	lockouts and strikes.....	278
coal mines, accidents.....	261	men employed.....	12, 279
accidents reportable.....	260	mining methods.....	277
days worked annually.....	264	coal production.....	279
disasters.....	261	per death.....	279
electric haulage motors, number of.....	87	per man.....	279
fatalities.....	264	Orenda mine, Boswell, Pa., explosion.....	73, 298
by causes.....	266	Orenda No. 2 mine, Boswell, Pa., explosion.....	72, 298
chart showing.....	26	Oswald mine, Princeton, Ind., explosion.....	70, 71, 181
fatality rates.....	264	Ott No. 20 mine, Elk Garden, W. Va., explosion.....	72, 342
chart showing.....	26	Otto Red Ash mine, Branch Dale, Pa., explosion.....	69, 287
on 2,000-hour basis.....	262	P.	
hours worked daily.....	262	Pacific Coast coal fields, area.....	135
inspection service.....	260	permissible explosives used.....	82
lockouts and strikes.....	263	Palos No. 3 mine, Alabama, explosion.....	72, 141
men employed.....	12, 264	Panama mine, Moundsville, W. Va., explosion.....	72, 342
method of ventilation.....	260	Pancoast-Price mine, Throop, Pa., fire.....	72, 288
mining machines, number.....	108, 264	Parker, E. W., on California coal fields.....	153
mining methods.....	259	on Georgia coal fields.....	166
number in operation.....	260	on number of working hours at coal mines.....	62
quantity of explosives used.....	81	on Pennsylvania bituminous coal fields.....	294
coal production.....	264	Parrel mine, West Virginia, explosion.....	71, 342
per death.....	264	Parrish mine, Plymouth, Pa., explosion.....	72, 288
per man.....	264	Patterson No. 2 mine, Elizabeth, Pa., accident.....	73, 298
Oklahoma, coal mined by hand, percentage.....	274	Payroll basis for computing fatality rates.....	60
mined by machine, percentage.....	274	Pennsylvania (anthracite) coal, value per ton at mine.....	290
shot off solid, amount.....	274	coal beds, character.....	231
value per ton at mine.....	274	coal fields, area.....	134, 281
coal beds, character.....	268		



	Page.		Page.
Pennsylvania (anthracite) coal mines, acci-		Permissible explosives used in Pennsylvania	
dents	286	coal mines	80
accidents reportable	284	in various coal fields	81, 82
air compressors, number of	85	<i>See also</i> Explosives.	
days worked annually	280	Perry & Keith No. 6 mine, Rich Hill, Mo.,	
disasters	287, 288	explosion	69, 230
electric dynamos, number of	85	Personal element relating to mine acci-	
explosives used, quantity of	80, 82	dents	4
fatalities	280	Pick machines in United States coal mines,	
by causes	292	number of	109
chart showing	26	<i>See also</i> States listed.	
from explosives	79	Pitch of coal seams, fatalities from	333
fatality rates	290	Pittston No. 14 mine, Pennsylvania, ex-	
by occupation	93, 94	plosion	72, 288
chart showing	26	Plateau coal field, Alabama	138
on 2,000-hour basis	288	Plymouth No. 2 mine, Pennsylvania, ex-	
horses and mules, number of	84, 85	plosion	69, 287
hours worked daily	288	Pocahontas mine, Virginia, fire and ex-	
inspection service	284	plosion	70, 71, 325
lockouts and strikes	289	Port Royal No. 2 mine, Pennsylvania, ex-	
locomotives in, number of	84, 85	plosion	70, 298
men employed	12, 290	Poteau No. 6 mine, Witteville, Okla., ex-	
mining methods	282	plosion	71, 271
coal production	290	Potts mine, Pennsylvania, explosion	69, 287
per death	290	Potts mine, Locust Dale, Pa., explosion	69, 287
per man	290	Premature blasts, fatalities from	78
Pennsylvania (bituminous) coal mined by		Preston No. 3 mine, Girardville, Pa., acci-	
hand, percentage	300	dent	69, 287
mined by machine, percentage	300	Price-Pancoast mine, Throop, Pa., fire	72, 288
shot off solid, amount	300	Primero mine, Colorado, explosion	71, 72, 159
value per ton at mine	300	Principal causes of accidents, percentage	
coal beds, character	294	killed, and number killed per 1,000	
coal fields, area	134, 294	employed	16, 19
coal mines, accidents	297	Production, anthracite coal	290
accidents reportable	296	bituminous coal	105
air compressors, number of	85	coal, by machines	110, 111
days worked annually	300	by States	20
disasters	298	in United States, 1807 to 1914	10
electric dynamos, number of	85	per death	10
explosives used, quantity of	80	per man	10, 20, 105
fatalities at	300	under inspection service	10
by causes	302	<i>See also</i> States listed.	
chart showing	26	Prospect mine, Wilkes-Barre, Pa., acci-	
fatality rates	300	dent	72, 73, 288
by occupation	93, 95	Providence No. 3 mine, Kentucky, explo-	
chart showing	26	sion	72, 208
on 2,000-hour basis	299		
horses and mules, number of	84, 85		
hours worked daily	299		
inspection service	296		
lockouts and strikes	299		
locomotives, number of	84, 85		
men employed	12, 300		
mining machines, number of	108, 300		
mining methods	295		
coal production	300		
per death	300		
per man	300		
Percentage basis for computing fatality rates	60		
coal mined by hand. <i>See</i> States listed.			
mined by machine. <i>See</i> States listed.			
produced under inspection	10		
shot off solid. <i>See</i> States listed.			
coal-mining industry under inspection	10, 20		
employees under inspection	10		
fatalities from principal causes	16		

	Page.		Page.
Rock Island No. 8 mine, Hartshorne, Okla., explosion.....	72, 271	Steam locomotives, number used in Pennsylvania.....	85
Rocky Mountain coal fields, area.....	135	West Virginia.....	86
permissible explosives used.....	82	<i>See also</i> Locomotives.	
Rolling Mill mine, Johnstown, Pa., explosion.....	70, 71, 298	Stearns No. 5 mine, Kentucky, explosion...	71, 208
Roof, falls of.....	82, 83	Stoek, H. H., on Pennsylvania anthracite coal fields.....	281
Rope system of haulage, Illinois mines.....	86	Stone Canyon mine, Chancellor, Cal., explosion.....	72, 153
Roslyn mine, Washington, explosion.....	70, 333	Strikes and lockouts. <i>See</i> States listed.	
Royalton No. 1 mine, Illinois, explosion.....	73, 172	Stuart mine, West Virginia, explosion.....	71, 342
Rush Run and Red Ash mine, Red Ash, West Virginia, explosion.....	71, 342	Suffocation by mine gases, fatalities from.....	14
S.		by powder gas, fatalities from.....	78
St. Paul No. 2 mine, Cherry, Ill., fire.....	72, 172	Sullivan mine, Indiana, explosion.....	69, 181
San Bois No. 2 mine, McCurtain, Okla., explosion.....	72, 271	Sumner mine, Pennsylvania, explosion.....	70, 298
San Toy No. 1 mine, Corning, Ohio, accident.....	71, 261	Sunnyside mine, Evansville, Ind., explosion.....	72, 181
Sandoval mine, Illinois, accident.....	71, 172	Sunshine mine, Colorado, explosion.....	70, 159
Seagraves mine, Eldorado, Ill., explosion...	72, 172	Superba and Lemont mine, Evans Station, Pa., accident.....	72, 298
Shaft accidents, number killed by.....	14, 16, 18, 19, 89, 90	Surface accidents, by causes.....	14, 92
Shaft mines in Ohio, number of.....	260	<i>See also</i> States listed.	
Shenandoah City mine, Pennsylvania, explosion.....	71, 287	Surface employees, fatality rates based on... number of.....	19 6, 19
Shoal Creek mine, Panama, Ill., explosion 72, 73, 172		Surface fatalities, number of men killed and fatality rates.....	16
Shooting off solid. <i>See</i> States listed.		Surface shops and yards, accidents at.....	14, 91, 92
Short Creek mine, Alabama, explosion.....	72, 141	Susquehanna No. 1 mine, Nanticoke, Pa., explosion.....	70, 287
Short-flame explosives. <i>See</i> Explosives.		Susquehanna No. 4 mine, Nanticoke, Pa., explosion.....	69, 287
Short-wall machines in United States, number of.....	109	Susquehanna No. 7 mine, Nanticoke, Pa., explosion.....	71, 288
<i>See also</i> Mining machines and States listed.		Sykesville mine, Pennsylvania, explosion...	72, 298
Shot breaking through pillar, fatalities from..	78	T.	
Skips. <i>See</i> Cages.		Tamping, fatalities from.....	78
Slope mines in Ohio, number of.....	260	Tate mine, Sturgis, Ky., explosion.....	70, 208
Smokeless Valley No. 1 mine, Johnstown, Pa., explosion.....	73, 298	Taylor mine, Hartford, Ky., accident.....	72, 208
Sonman mine, Pa., accident.....	71, 298	Tennessee coal mined by hand, percentage... mined by machine, percentage.....	308 308
South Dakota coal field in, area of.....	135	shot off solid, amount.....	308
South Wilkes-Barre mine, Pennsylvania, explosion.....	71, 72, 287, 288	value per ton at mine.....	308
South Wilkes-Barre No. 5 mine, Pennsylvania, explosion.....	72, 288	coal beds, character of.....	304
South Wilkes-Barre shaft No. 3, Pennsylvania, explosion.....	69, 70, 287	coal fields in, area.....	134, 304
Southern Appalachian coal field, permissible explosives used.....	82	coal mines, accidents.....	306
Spencer mine, Pottsville, Pa., explosion....	69, 287	accidents reportable.....	305
Spencer-Newland mine, Mulberry, Kans., accident.....	73, 198	days worked annually.....	308
Spontaneous combustion in mines, fires caused by.....	76	disasters.....	306
Spring Gulch mine, Colorado, explosion....	70, 159	fatalities.....	308
Spring Mountain No. 1 mine, Jeanesville, Pa., accident.....	70, 287	by causes.....	310
Stafford mine, West Virginia, explosion....	71, 342	chart showing.....	26
Stag Canyon No. 2 mine, Dawson, N. Mex., explosion.....	73, 246	fatality rates.....	308
Starkville mine, Colorado, explosion.....	72, 159	chart showing.....	26
Statistics of coal mines, by States.....	133	on 2,000-hour basis.....	307
source and scope of.....	4	hours worked daily.....	307
<i>See also</i> States listed.		inspection service.....	305
		lockouts and strikes.....	307
		men employed.....	12, 308
		mining machines, number.....	108, 308
		mining methods.....	304
		coal production.....	308
		per death.....	308
		per man.....	308
		Tercio mine, Colorado, explosion.....	71, 159

	Page.		Page.
Texas, coal mined by hand, percentage.....	314	United States Geological Survey, acknowl-	
mined by machine, percentage.....	314	edgment to.....	5
shot off solid, amount.....	314	coal-field areas estimated by.....	133
value per ton at mine.....	314	Utah, coal mined by hand, percentage.....	320
coal beds, character.....	311	mined by machine, percentage.....	320
coal field in, area.....	135, 311	shot off solid, amount.....	320
coal mines, accidents.....	312	value per ton at mine.....	320
accidents reportable.....	312	coal beds, character.....	316
days worked annually.....	314	coal field in, area.....	135, 316
fatalities.....	314	coal mines, accidents.....	317
by causes.....	315	accidents reportable.....	317
chart showing.....	26	days worked annually.....	320
fatality rates.....	314	disasters.....	317
chart showing.....	26	fatalities.....	320
on 2,000-hour basis.....	313	by causes.....	322
hours worked daily.....	313	chart showing.....	26
inspection service.....	312	fatality rates.....	320
lockouts and strikes.....	313	chart showing.....	26
men employed.....	12, 314	on 2,000-hour basis.....	319
mining machines, number.....	108, 314	hours worked daily.....	319
mining methods.....	311	inspection service.....	317
coal production.....	314	lockouts and strikes.....	319
per death.....	314	men employed.....	12, 320
per man.....	314	mining machines, number.....	108, 320
Thawing explosives, fatalities from.....	78	mining methods.....	316
Thomas No. 25 mine, West Virginia, explo-		coal production.....	320
sion.....	71, 342	per death.....	320
Tidewater mine, Vivian, W. Va., explosion.....	71, 342	per man.....	320
Toller mine, Tollerville, Colo., explosion.....	72, 159		
Tonnage basis for computing fatality rates.....	60	V.	
Transportation of explosives, fatalities from.....	78	Ventilation of coal mines in Ohio.....	260
Trinidad coal field, Colorado.....	156	Victor American No. 3 mine, Delagua, Colo.,	
Tripp mine, Scranton, Pa., accident.....	73, 288	fire and explosion.....	72, 159
Trolley wire, contact with, fatalities from.....	88	Virginia, coal mined by hand, percentage....	328
tool or bar striking, fatalities from....	88	mined by machine, percentage.....	328
Twin mine, Pittston, Pa., accident.....	70, 287	shot off solid, amount.....	328
Two-thousand-hour workers, fatality rates		value per ton at mine.....	328
based on.....	61, 62	coal beds, character.....	323
number.....	61, 62	coal fields, area.....	134, 323
<i>See also</i> States listed.		coal mines, accidents.....	325
Tunnel mine, Ashland, Pa., accident.....	69, 287	accidents reportable.....	324
U.		days worked annually.....	328
Umpire mine, Brownsville, Pa., explosion..	70, 298	disasters.....	325
Underground employees, fatality rates.....	19	fatalities.....	328
by principal causes.....	19	by causes.....	329
number.....	6, 19	chart showing.....	26
Unexploded charges, drilling into.....	78	fatality rates.....	328
Uniform time basis for computing fatality		chart showing.....	26
rates.....	62	on 2,000-hour basis.....	327
Union Pacific No. 2 mine, Cumberland, Wyo.,		hours worked daily.....	326
accident.....	73, 350	inspection service.....	324
United Coal No. 1 mine, Christopher, Ill.,		men employed.....	12, 328
explosion.....	72, 172	mining machines, number.....	108, 328
United Kingdom. <i>See</i> Great Britain.		mining methods.....	324
United States, coal, value per ton at mine...	10	coal production.....	328
coal mines, disasters, list of.....	69	per death.....	328
fatalities by calendar years and States,		per man.....	328
1870 to 1914.....	27-59	Virginia City mine, Alabama, explosion....	71, 141
by causes.....	14	Von Storch mine, Scranton, Pa., fire.....	70, 287
by States, 1839 to 1914.....	7, 8, 9	Vulcan mine, New Castle, Colo., explosion... 70,	
chart showing.....	26		73, 159
men employed, by States.....	12	W.	
mining machines, number.....	108	Wadesville mine, Pennsylvania, accident ..	70, 287
coal production.....	10	explosion.....	69, 287
		Warrior coal field, Alabama.....	137



	Page.		Page.
Warrier Run mine, Wilkes-Barre, Pa., accident.....	72, 288	West Virginia coal mines, men employed..	12, 344
Washington, coal mined by hand, percentage.....	336	mining machines, number.....	108, 344
mined by machine, percentage.....	336	mining methods.....	340
shot off solid, amount.....	336	quantity of explosives used.....	81
value per ton at mine.....	336	coal production.....	344
coal beds, character of.....	330	per death.....	344
coal field in, area.....	135, 330	per man.....	344
coal mines, accidents.....	332	Western interior coal fields, area.....	135
accidents reportable.....	331	permissible explosives used.....	82
days worked annually.....	336	Western No. 5 mine, Lehigh, Okla., fire....	72, 271
disasters.....	333	Whipple mine, Scarboro, W. Va., explosion.	71, 342
fatalities.....	336	White & Cook mine, Madrid, N. Mex., explosion.....	70, 246
by causes.....	338	White Ash mine, Cerrillos, N. Mex., explosion.....	70, 246
chart showing.....	26	White Ash mine, Jefferson County, Colo., accident.....	69, 159
from dip or pitch of coal.....	333	Wilburton No. 19 mine, Oklahoma, explosion.....	71, 271
fatality rates.....	336	Williamstown mine, Pa., accident.....	71, 287
chart showing.....	26	explosion.....	72, 288
on 2,000-hour basis.....	334	Winter Quarters mine, Scofield, Utah, explosion.....	70, 318
hours worked daily.....	334	Wyoming, coal mined by hand, percentage..	352
inspection service.....	331	mined by machine, percentage.....	352
lockouts and strikes.....	335	shot off solid, amount.....	352
men employed.....	12, 336	value per ton at mine.....	352
mining machines, number.....	108, 336	coal beds, character.....	347
mining methods.....	331	coal fields in, area.....	135, 347
coal production.....	336	coal mines, accidents.....	349
per death.....	336	accidents reportable.....	348
per man.....	336	days worked annually.....	352
Washington No. 5 mine, Franklin, Md., accident.....	72, 215	disasters.....	350
West Bear Ridge mine, Mahanoy Plane, Pa., explosion.....	70, 287	fatalities.....	352
West End mine, Mocanaqua, Pa., accident ..	69, 287	by causes.....	353
West Leisenring mine, Pennsylvania, explosion.....	69, 298	chart showing.....	26
West Pittston mine, Pennsylvania, breaker fire.....	69, 287	fatality rates.....	352
West Virginia, coal mined by hand, percentage.....	344	chart showing.....	26
mined by machine, percentage.....	344	on 2,000-hour basis.....	351
shot off solid, amount.....	344	hours worked daily.....	350
value per ton at mine.....	344	inspection service.....	348
coal beds, character.....	339	lockouts and strikes.....	351
coal fields in, area.....	134, 339	men employed.....	12, 352
coal mines, accidents.....	241	mining machines, number.....	108, 352
accidents reportable.....	340	mining methods.....	348
days worked annually.....	344	coal production.....	352
disasters.....	342	per death.....	352
fatalities.....	344	per man.....	352
by causes.....	346		
chart showing.....	26		
fatality rates.....	344		
chart showing.....	26		
on 2,000-hour basis.....	343		
haulage system.....	86		
hours worked daily.....	343		
inspection service.....	340		
lockouts and strikes.....	343		

Y.

Yolande mine, Alabama, explosion.....	71, 72, 141
York Farm mine, Pottsville, Pa., explosion.	70, 287
Youngstown mine, Uniontown, Pa., explosion.....	69, 298

Z.

Zeigler mine, Ill., fire and explosion.....	72, 172
---	---------







